VOLUME 29 NUMBER 4

NEXT MONTHLY MEETING, NOVEMBER 12, 1907

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

PROCEEDINGS

NOVEMBER 1907

NEW YORK MEETING, DECEMBER 3-6, 1907

NOVEMBER 1907 VOL. 29 No. 4

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

PROCEEDINGS

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
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1906-1907

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E. D. MEIER .... New York, N. Y.

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PROCEEDINGS

OF

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

VOL. 29 NOVEMBER 1907 NUMBER 4

Elevators for high office buildings will be the subject under discussion at the November meeting of the Society. Engineers and architects from New York, Philadelphia and Chicago have been invited to participate.

The principal address of the evening, "A High Speed Elevator," by Mr. Charles R. Pratt, of New York, is published in October Proceedings. It treats of the type of Electric Elevator to be placed in the Singer and Metropolitan Life buildings, which when successfully completed, will represent the most modern elevator equipment.

MONTHLY MEETINGS

Members are reminded that papers read before any monthly meeting are considered for the Transactions equally as if presented at the Annual or Spring meetings. By means of the regular issue of the Proceedings equal publicity is also given.

VOLUME 28

Carrying out the above direction, Volume 28 is about to go to press and will include the papers presented in the fall and winter to December 31, 1906, concluding the work of the previous year.

IMPORTANT CHANGE IN THE DATE OF TRANSACTIONS

Upon the recommendation of the Publication Committee and the approval of the Council the Transactions will in future cover the calendar year instead of the fiscal year.

This change will facilitate the memory in locating papers according to the year in which a paper was presented and also secure in one volume all of the work of one administration.

REPORT OF THE NOMINATIONS COMMITTEE

October 5, 1907.

Secretary, The American Society of Mechanical Engineers,

DEAR SIR: The committee appointed by the President of The American Society of Mechanical Engineers to nominate officers for that organization for the year 1908, beg to report as follows:

The number of names suggested by the members of the Society for the various offices was very large, and in making a necessarily limited selection the endeavor of the Committee has been to promote the largest possible interests of the Society. With this in view our unanimous choice for the several offices has been as indicated below:

For President

M. L. HOLMAN, St. Louis, Mo.

For Vice-Presidents

L. P. BRECKENRIDGE, Urbana, Ill. FRED. J. MILLER, New York, N. Y.
ARTHUR WEST, Pittsburg, Pa.

For Managers

WM. L. ABBOTT, Chicago, Ill. ALEXANDER C. HUMPHREYS, New York, N. Y.
HENRY G. STOTT, New York, N. Y.

For Treasurer

WM. H. WILEY, New York, N. Y.

All of the above-named gentlemen have consented to allow their names to appear upon the next ballot of the Society in the capacities indicated.

Respectfully submitted,

STRICKLAND L. KNEASS
F. E. KIRBY
C. H. MANNING
ROBERT W. HUNT
R. H. FERNALD, *Chairman.*

CONSOLIDATION OF A. S. M. E. AND M. E. L. A.

Chief Justice Blanchard of the Supreme Court, on October 21, granted an order permitting The American Society of Mechanical Engineers and The Mechanical Engineers Library Association to consolidate under the name of The American Society of Mechanical Engineers.

FORWARD WORK

During the year just passed there has been in all engineering societies a remarkable activity and growth. In this general forward movement our own Society has participated perhaps as largely as any other. It is gratifying to note that, while our organization occupies a distinctly stronger position today than twelve months ago, it is not because of any single event or on account of development along any single line, but because in all our avenues of endeavor notable progress has been made.

We desire especially to emphasize the great results accomplished this year through the increased activity of the various Standing Committees. Our plan of government is so designed as to permit the widest scope for committee action. If we as a Society are, in a larger measure, to take possession of the field of mechanical engineering in this country it must be through the activities of our committees.

PARTICIPATION OF THE SOCIETY IN PUBLIC AFFAIRS

An activity which we are earnestly hoping will shortly be taken up by the Society is the general participation in public engineering affairs and works. It was particularly pleasing and gratifying to find that a number of members of this Society participated as Jurors of Awards at the Jamestown Exposition and that our Past-President, Mr. Swasey, was the Vice-President and Administrator of the Board. The other members on the Jury were Messrs. Lanza, Carpenter, Dodge, Swenson and Birkinbine.

Abroad, particularly in Germany and France, no great engineering works are undertaken without consultation with and sometimes an appointed committee for investigation from the engineering societies of the respective countries. Our members are often engaged in works of a public character, and in order to promote this desirable relation between the Government, the people and our Society, the membership in our Society should be more advertised. Further, whenever there are public works to be undertaken, influential members should strive to secure representation from the Society. It is particularly hoped that the members of the Society will participate *as such* in trying to shape technical education. In Germany there is a Standing Committee of the Verein Deutscher Ingenieure on technical education and the Government makes no changes in the curriculum of the technical schools without consulting the committee of the Verein.

MEETINGS AND PUBLICATION COMMITTEES

The activities of the Society have been so great that twice as much material has been printed as in any previous year. This has been a great burden on the committees but the members of the Society are appreciative of their efforts which have resulted so successfully.

LAND AND BUILDING FUND

About \$60 000 is yet to be raised to free the Society from its obligations and to place it on a par with the other Founder Societies. The Committee has been especially successful in securing \$65 000 in cash of the \$70 000 promised. However, as only 10 per cent of the membership has been heard from there is yet much to be done by those who have not responded.

The Committee is Mr. Fred J. Miller, Chairman, Col. R. C. McKinney and James M. Dodge Esq., Past-President of the Society.

Any member inclined to participate in this activity is invited to correspond direct with the Committee.

MEMBERSHIP COMMITTEE

During the last fiscal year 503 members and promotions were recommended and accepted by the Society. This is the approval of the greater usefulness of the Society by the members of the profession. The increased membership however means much work by a very conscientious committee who, of course, have considered a much larger number of applications than above mentioned. This work required sixteen meetings, and the Society is grateful for the faithful attendance of the Committee.

The present membership is 16 Honorary Members, 2262 Members, 324 Associate Members, and 732 Juniors, total 3334.

LIBRARY COMMITTEE

The Society is aware of the work accomplished by this Committee in effecting a working arrangement of the three libraries.

Members have asked for the privileges of the library during the evening, and the Committee is pleased to announce that the library will be open from nine o'clock in the morning until ten o'clock in the evening beginning Monday, November 4.

This Committee is also the custodian of the objects of interest in the Society rooms and will be grateful if any member will present to the Society works of art or of scientific interest.

The past week we received a copy on parchment of one of the earliest patents issued by the United States. Such documents are properly displayed either in the Society rooms or the Library and add greatly to the interest of the exhibits.

It may be stated further in this connection, that the Society building is absolutely fireproof.

RESEARCH COMMITTEE

The By-Law under which the Research Committee will work is in course of preparation and the first Standing Committee on research will be appointed by the incoming President. During the coming year at least the beginnings ought to be accomplished of a work which, properly fostered, is destined to have a large significance.

The determination of the specific heat of superheated steam has already been referred to this Committee. Another question to be submitted to them is the possibility of coördinating the research activities of the various technical schools so as to make it possible to undertake some large single piece of work. This is something, so far as we know, not done in any other part of the world. It is brand new and can be accomplished without the expenditure of money.

STANDARDIZATION COMMITTEE

The move from our former headquarters was made the occasion for the installation of a complete new machinery of administration. The Society's office is now provided with the most approved equipment of modern business offices. The routine of every function has been thoroughly overhauled and up to date business methods, such as are found in successful business houses, have been introduced. The system provides for an indefinite extension of any branch of the work and produces daily, weekly, or monthly reports for the use of the various Committees and the Officers of the Society. These reports are on file in the Secretary's office and are open at all times to the inspection of the membership. All of the standards by which every act of the Society is performed are carefully typewritten and indexed. The books containing these standards make two large folios and are maintained in the office of the Office Manager for consultation by all

the members of the office staff or by members of the Society. While this reorganization has been instrumental in effecting large economies in administration, its more important result has been a largely increased capacity for service to the Committees and the members individually.

Our strength is in our readiness to serve. Practically the entire expense of this work was donated by our Past-President, Mr. Fred W. Taylor. He has, in addition, given it his personal supervision over a period of nearly two years.

SOCIETY HISTORY

The Committee on Society History, Messrs. Sweet, Hunt and Suplee are ready to make a report. This report will be published first as a serial in Proceedings, so that the matter may get the benefit of criticism before its publication in permanent form. This form will be in a separate volume, uniform in size and binding with the Transactions. The history, together with the photogravures of each of the Presidents and half tone cuts of the several officers of the Society, will be a very valuable contribution to the published works.

PROGRAM OF THE ANNUAL MEETING

A tentative program of the Annual Meeting to be held in the Engineering Societies Building, New York, December 3–6, is given below. This is the first Annual Meeting of the Society in the new headquarters, the Engineering Societies Building. As a special feature all of the Honorary Members have been invited to attend.

OPENING SESSION

Tuesday evening, December 3, 8:45 o'clock

The President's Address............Prof. F. R. Hutton, New York

THE BROADER USEFULNESS OF THE SOCIETY

An informal reception will be held in the auditorium after the address which will afford members an opportunity for social intercourse. Ladies are especially welcome.

SECOND SESSION

Wednesday morning, December 4, 9:30 o'clock

Business Meeting. Reports of the Tellers on Election of Members and Report of Standing and Special Committees. New business can be presented at this Session.

GAS POWER

THE RATIONAL UTILIZATION OF LOW GRADE FUELS IN GAS PRODUCERS..............................Mr. F. E. Junge

DUTY TEST ON GAS POWER PLANT.............Mr. J. R. Bibbins

Buffet luncheon will be served at one o'clock.

EXCURSION

Wednesday afternoon, December 4, 2:30 o'clock

UNASSIGNED

Wednesday evening, December 4

THIRD SESSION

Thursday morning, December 5, 9:30 o'clock

FOUNDRY PRACTICE

The Foundry Department and the Department of Engineering Design.......................... Mr. W. A. Bole
Molding Sand.......................... Mr. A. E. Outerbridge
Power Service in the Foundry............. Mr. A. D. Williams
Foundry for Bench Work, Mr. W. J. Keep and Mr. Emmett Dwyer

FOURTH SESSION

Thursday afternoon, December 5, 2 o'clock

FOUNDRY PRACTICE

Specifications for Iron, Coke and Method of Testing Output.................................. Mr. R. Moldenke
Foundry Cupola and Iron Mixtures........... Mr. W. J. Keep
Foundry Blower Practice.................. Mr. W. B. Snow
Patterns for Repetition Work.............. Mr. E. H. Berry
Some Limitations of Molding Machines...... Mr. E. H. Mumford

RECEPTION

Thursday evening, December 5, 9 o'clock

The reception will be held in the foyer of the Engineering Societies Building at 9 o'clock. This is the distinctively social feature of the meeting and the attendance of the ladies is particularly desired. It is urged that no one shall remain away because the exigencies of travel have made evening dress inconvenient. Members must secure cards for themselves and friends to this reception.

FIFTH SESSION

Friday morning, December 6, 9:30 o'clock

The Specific Heat of Superheated Steam.... Prof. C. C. Thomas
Engine Design Adapted for the Use of Superheated Steam............................ Mr. Max E. R. Toltz
Power Transmission by Friction Driving.... Prof. W. F. M. Goss
Cylinder Port Velocities................. Mr. J. H. Wallace
Industrial Education..................... Mr. W. B. Russell

RAILROAD TRANSPORTATION NOTICE

Special concessions have been secured for members and guests attending the Annual Meeting in New York, December 3–6. Read carefully the following details.

The Trunk Line Association, the New England Passenger Association, except the Eastern Steamship Company, the Eastern Canadian Passenger Association and the Southeastern Passenger Association have granted the special rate of a fare and one-third for the round trip, when the regular fare is 75 cents and upwards.

a Buy your ticket at full fare for the going journey, between November 29 and December 5 inclusive. At the same time request a certificate, not a receipt. This ticket and certificate should be secured at least half an hour before the departure of the train.

b Certificates are not kept at all stations. Find out from your station agent whether he has certificates and through tickets. If not, he will tell you the nearest station where they can be obtained. Buy a local ticket to that point, and there get your certificate and through ticket.

c On arrival at the meeting, present your certificate to Mr. S. Edgar Whitaker at the Headquarters. A fee of 25 cents will be collected for each certificate validated. No certificate can be validated after December 6.

d An agent of the Trunk Line Association will validate certificates December 4, 5 and 6. No refund of fare will be made on account of failure to have certificate validated.

e One hundred certificates must be presented for validation before the plan is operative. This makes it important to ask for certificate.

f If certificate is validated, a return ticket to destination can be purchased, up to December 10, on the same route over which the purchaser came.

The Central Passenger Association offer a special concession of two cents per mile in each direction from points in their territory to Buffalo, Pittsburg, Parkersburg and other eastern gateways. From these points a fare and one third for the round trip will apply.

a Send to Mr. S. Edgar Whitaker, Office Manager, 29 West 39th Street, New York, for a *card order* to get a round trip ticket at reduced rates.

b Present the card, identifying you, to your ticket agent December 1, 2 or 3. This will enable you to buy a round trip ticket at the reduced rates, good for return until December 10.

c When ready to leave New York, present your ticket to the New York ticket agent, that he may witness your signature and stamp the ticket, then it will be good for the return journey.

The Western Passenger Association offer revised one-way fares to Chicago, Peoria and St Louis; these three places are points in the Central Passenger Association, and from these points purchase round trip tickets, in the manner outlined in the preceding paragraphs referring to the Central Passenger Association. The card orders must not be presented to ticket agents of western lines, as they will not be honored.

The Trunk Line Association includes the following territory:

All of New York east of a line running from Buffalo to Salamanca, all of Pennsylvania east of the Ohio River, all of New Jersey, Delaware and Maryland; also that portion of West Virginia and Virginia north of a line running through Huntington, Charleston, White Sulphur Springs, Charlottesville and Washington, D. C.

The Eastern Canadian Passenger Association includes:

Canadian territory east of and including Port Arthur, Sault Ste. Marie, Sarnia and Windsor, Ont.

The Southeastern Passenger Association includes:

Kentucky, all of West Virginia and Virginia south of a line running through Huntington, Charleston, White Sulphur Springs, Charlottesville and Washington, D. C., North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi and Tennessee.

The Central Passenger Association includes:

The portion of Illinois south of a line from Chicago through Peoria to Keokuk and east of the Mississippi River, the States of Indiana, and Ohio, the portion of Pennsylvania and New York north and west of the Ohio River, Salamanca and Buffalo, and that portion of Michigan between Lakes Michigan and Huron.

The Western Passenger Association includes:

North Dakota, South Dakota, Nebraska, Kansas, Colorado; east of a north and south line through Denver, Iowa, Minnesota, Wisconsin, Missouri; north of a line through Kansas, Jefferson City and St. Louis, Illinois; north of a line from Chicago through Peoria to Keokuk.

The New England Passenger Association includes:

Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.

OBITUARY

GEORGE ROWLAND

George Rowland was born in Brooklyn, N. Y., December 22, 1865. He attended school at several private institutions, and completed his education at Columbia University, graduating from the School of Mines in the class of 1887 with the degree of Civil Engineer.

Mr. Rowland entered the employ of the Continental Iron Works immediately after graduating, and remained continuously with that company, holding the position of assistant treasurer at the time of his death.

He was an active member of several scientific and patriotic societies, and was especially identified with the management of Webb's Academy and Home for Shipbuilders, New York, being a member of the Governing Board. He joined the Society as a Junior Member in 1887 and as a full Member in 1894.

Mr. Rowland died July 7, 1907 after an illness of several months.

EMPLOYMENT BULLETIN

The Society has always considered it a special obligation and pleasant duty to be the medium of securing better positions for its members. The Secretary gives this his personal attention and is most anxious to receive requests both as to positions and as to men available. Notices are not repeated except upon special request. Copy for notices in this Bulletin should be received before the 15th of the month. The list of men available is made up entirely of members of the Society and these are on file, with the names of other good men, not members of the Society, capable of filling responsible positions, information about whom will be sent upon application.

POSITIONS AVAILABLE

077 Expert on steel foundry practice to criticise and report on present foundry methods of Massachusetts concern, from standpoint of most modern practice.

078 Shop manager; man of wide experience in die making and handling of metal products.

079 Four draftsmen: (*a*) experienced in general machine design; (*b*) design of ordinary factory buildings; (*c*) steam electric power plant; (*d*) general work.

MEN AVAILABLE

138 Mechanical and electrical engineer, 15 years practical experience, wishes position where exceptional skill, reliability and originality are required; specialty, electrical and mechanical machine design.

139 Junior member, experienced in tool designing, building and equipping industrial plants, mill construction and reinforced concrete; laying out, building and operating steam turbine power plants.

140 Technical graduate, five years' successful experience as engineering salesman and manager of branch office of large concern manufacturing general line of power and heating machinery desires executive position in business end of company.

141 Member, age 36, graduate mechanical engineering, from a leading technical institute, having wide experience in supervision of installation and operation of power plants, desires position as

superintendent of motive power of moderate sized electric railway system.

142 Member, technical graduate, 16 years in charge of design of light and medium interchangeable machinery and the tools for its production, also plant construction and maintenance.

143 Cornell graduate, married, 32 years old, experienced in steam, gas, and water power generation, high voltage transmission; management and accounting of organizations; present salary $3500.

144 Junior member, Yale graduate, aged 32, desires position as superintendent in or near Chicago; experienced in machine shop and factory work as draftsman and assistant superintendent.

145 Member, technical graduate, experienced in the States and abroad as chief draftsman, superintendent and representative salesman, desires change of position.

146 Member, desires position as superintendent or manager; thorough practical man of wide experience on special automatic machinery; gas producers, steam pumps, hydraulics, tools, sheet metal work, etc.

147 Member, age 46, desires position as works manager or superintendent; has had full charge of large plants for the manufacture of watches, precision tools and machinery, machine tools, and electrical apparatus; connection wanted with company doing large business in accurate mechanisms.

148 Responsible position in New York City in executive or engineering capacity desired by member with 13 years experience along engineering and commercial lines; Graduate of Mass. Inst. Tech. in mechanical engineering, with post graduate course in electrical engineering. Present salary $5000.

149 Junior, graduate Pennsylvania, three years experience with steam boilers and distilling apparatus, desires position in connection with steam engineering work.

150 Junior member wishes position as chief draftsman with moderate size company; seven years' experience in steam, electric and gas driven prime movers, and in power installation.

151 Graduate Univ. of Penna., age 37, with extended mechanical and electrical experience and some knowledge of water power, desires work with engineering, contracting or manufacturing firm. Ten years in construction department of large electric railway; testing, estimating, design and superintendence. Contracting and consulting engineering business.

152 Cornell graduate; general engineering experience designing, estimating, selling and as assistant manager; specialized in sugar and paper pulp machinery.

153 Wide experience as general manager, sales manager or general superintendent and mechanical engineer. Graduate Worcester Polytechnic.

CHANGES OF ADDRESS

ADAMS, Julius Leroy (1900) Dist. Mgr., Ohio Electric Railway Co., Springfield, O.

ALLEN, Geo. L. Jr., (Junior, 1906) 26 W. Mooreland Pl., St. Louis, Mo.

AULL, Jerome J. (Junior, 1906) 806 Academy Ave., Cincinnati, O.

BARBOUR, George H. (Associate, 1902) 42 Broadway, New York, N. Y.

BARNES, Charles Ballou (Junior, 1905) Mech. Engr., Holabird & Roche, Architects, 1618 Monadnock Bldg., and for mail, 6045 Kimbark Ave., Chicago, Ill.

BARTLETT, Henry (1897) Genl. Supt., Mech. Dept., Boston & Maine R. R., North Station, Boston, and for mail, 91 Walker St., Cambridge, Mass.

BAUSH, George Henry (1905) Genl. Mgr., Hill, Clarke & Co., 512 Arch St., and 2219 Green St., Philadelphia.

BENJAMIN, Chas. Henry (1892) Dean of the Schools of Engineering, Purdue University, and 629 University St., Lafayette, Ind.

BENNETT, George G. (Junior, 1903) Engrg. Dept., American Thread Co., and for mail, 30 Arlington St., Holyoke, Mass.

BERTSCH, John Charles (1901) Refrigerating Engr., 16 Nevaro Flats, Macon, Ga.

BIGELOW, Charles H. (1904) Insp. Engr., Hudson & Manhattan R. R. Co., Power Sta., and for mail, 128 Claremont Ave., Jersey City, N. J.

BRISSELL, F. M. (Junior, 1902) Estimator, John Simmons Co., 110 Centre St., New York, and for mail, 176 Halsey St., Brooklyn, N. Y.

BROOKS, Paul Raymond, (Junior, 1905) Sales Dept., Otto Gas Engine Wks., 4912 Woodlawn Ave., Chicago, Ill.

BUCKLEY, John Francis (1906) Mech. Engr., 846 Harrison Ave., Beloit, Wis.

CARPENTER, Alfonso H. (Associate, 1895) Vice Pres., The Acme Machinery Co., 4533 St. Clair Ave., and for mail, 11 414 Mayfield Road, S. E., Cleveland, Ohio.

CAZENOVE, Louis A. de (Junior, 1905) Constr. Dept., E. I. Du Pont De Nemours Powder Co., and The Brandywine Apts., Delaware Ave., Wilmington, Del.

CHAMBERLAIN, Harry M. (1907) 17 Wrentham St., Dorchester Center, Mass.

CHRISTIE, Alexander Graham (Associate, 1907) Box 88, Exshaw, Alberta, Canada.

COOK, Thomas Fowke (Junior, 1904) Lackawanna Iron & Steel Co., Buffalo, N. Y.

COOKE, St. George H. (Junior, 1905) Res. Engr., Ridley Park, Pa.

CORK, Robert L. (Junior, 1907) Gasholder Engr., Western Gas Cons. Co., and for mail, 118 E. Leith St., Fort Wayne, Ind.

CRAMP, Edwin S. (1888) 127 E. 61st Street, New York, N. Y.

DARBEE, William (Junior, 1900) Asst. Genl. Mgr., Consolidated Gas Electric Light and Power Co. of Baltimore, Baltimore, Md.

DELANY, Chas. H. (1907) Engr., Babcock & Wilcox Co., Bayonne, and for mail, 326 Union Ave., Elizabeth, N. J.

DOW, Carl Stephen (1899; Associate 1905) Mgr. of Publicity, B. F. Sturtevant Co., and for mail, 24 Milton Sq., Hyde Park, Mass.

EILERS, Karl Emrich (1890; 1904) Am. Smelting Securities Co., 71 Broadway, and Ardsley Hall, 320 Central Park West, New York, N. Y.

FALKENAU, Arthur (1886) Mech. Engr., care Mrs. Eidlitz, 995 Madison Ave., New York, N. Y.

FANNON, William A. (1907) Interlake Pulp & Paper Co., and for mail, 460 Alton St., Appleton, Wis.

FERRY, Charles H. (Associate, 1892) Life Member, Room 603, 114 Liberty St., New York, N. Y.

FULLER, Floid M. (Junior, 1907) Technology Chambers, Boston, Mass.

GARDNER, Horace C. (1904) 4523 Greenwood Ave., Chicago, Ill.

GEORGE, J. Z. (1901; Associate, 1905) present address unknown.

GREENE, Arthur M. Jr., (1895; 1903) Prof. Mech. Engrg., Rensselaer Polytechnic Inst., and 20 Hawthorne Ave., Troy, N. Y.

GREENMAN, Edwin G. (Junior, 1907) Ch. Draftsman, The Lunkenheimer Co., and 1536 Waverly Pl., Cincinnati, O.

GREUL, W. Herman (1907) Vaughn Brothers, Cooper's Point, Camden, N. J.

GRIMSHAW, Frederick G. (Junior, 1901) M. M., West Jersey & Seashore R. R., and for mail, 531 Penn St., Camden, N. J.

GOODRICH, Robert R. (1903) Prof. of Metallurgy, University of Arizona, Tucson, Arizona.

GORDON, Fred W. (1880) Mech. Engr., Niles Bement Pond Co., 111 Broadway, and for mail, Hotel Stirling, West 56th St., New York, N. Y.

GOSS, W. F. M. (1886) Life Member, Dean College of Engrg., University of Illinois, Urbana, Ill.

GWILLIAM, Geo. T. (1891) Resident Mgr., Webster Mfg. Co., Pennsylvania Bldg., and for mail, Union League Club, Philadelphia, Pa.

HACKSTAFF, John D. (Junior, 1901) present address unknown.

HAGERTY, Walter Wm. (Junior, 1905) Room 402 Buckeye Bldg., Lima, O.

HAIGHT, Harry Vercoe (1899; 1907) Ch. Engr., Canadian Rand Co., (Ltd.), and for mail, 30 Portland Ave., Sherbrooke, Quebec, Canada.

HALL, Morris Albert (1905; Associate, 1906) Asst. Mgr. and Ch. Engr., Mach Bros. Motor Car Co., and for mail, 1338 Walnut St., Allentown, Pa.

HAMNER, Chas. Sutherland (1901) 51 Liberty St., New York, N. Y.

HEALD, George Washburn (Junior, 1899) Mech. Engr. and Ch. Draftsman, Bates Mch. Co., and for mail, 105 Sherman Court, Joliet, Ill.

HERBERT, Frederick Davis (1899; 1907) Allis-Chalmers Co., 71 Broadway, New York, N. Y., and for mail, Hewitt, N. J.

HESS, Howard D. (1903) Asst. Prof. Mch. Design, Cornell University, 7 South Ave., Ithaca, N. Y.

HUDSON, Wilbur Gregory (1906) Vice Pres., Guarantee Constr. Co., 90 West St., New York, N. Y.

HUTSON, Henry L. (Associate, 1906) Texas Rep., A. M. Lockett & Co., Ltd., 507 Houston Land and Trust Bldg., Houston, Texas.

HULBERT, William Rowsell (Associate, 1906) Sales Mgr., Goldschmidt Thermit Co., 90 West St., New York, N. Y.

HYMAN, D. (1892) Owner, St. Lawrence Marble Quarries, Gouverneur, and for mail, Empire Limestone Co., Virginia and 4th Sts., Buffalo, N. Y.

JOHNSTON, John Parry (1907) Stony Brook, Suffolk, Co., and for mail, Engineers Club, 32 W. 40th St., New York, N. Y.

KAUP, Wm. Joseph (Junior, 1900) 106 Brandon Pl., Ithaca, N. Y.
KEVORKIAN, Zareh H. (Junior, 1905) Cambria Steel Co., Johnstown, Pa.
KING, Roy Stevenson (Junior, 1904) Asst. Genl. Mgr., Keppele Hall Co., 1111 N. B. Bldg., and for mail, 1911 N. Main St., Dayton, O.
KNIGHT, Geo. Laurence (Associate, 1905) Designing Engr., Edison Elec. Ill. Co., of Brooklyn, 36 Pearl St., and 152 Prospect Park W., Brooklyn, N. Y.
KNISKERN, Walter Hamlin (Junior, 1905) Hays, Kansas.
KNOOP, Theo. M. (Junior, 1904) 1105 S. Franklin St., New Orleans, La.
KUNTZ, Wellington W. (Associate, 1903) Freichler, Pa.
LANE, Almeron M. (1892) Life Member, 34 Walnut Ave., Waterbury, Conn.
LANE, Harry M. (1886) Pres., The Lane & Bodley Co., and for mail, John and Water Sts., Cincinnati, O.
LANE, Henry Marquette (1900) Editor, "Castings" and Secy., The Foundry Supply Asso., 1137 Schofield Bldg., Cleveland, O.
LIEB, John W., Jr., (1886) 3d Vice Pres., and Assoc. Genl. Mgr., The New York Edison Co., 55–57 Duane St., and for mail, 869 West End Ave., New York, N. Y.
LODETTI, Frank Emil (Junior, 1902) The Gothard Mining & Engrg. Co., Managing Engr., 19 W. 24th St., New York, N. Y.
MAGEE, John (Junior, 1907) Genl. Mgr., Missoula & Bitter Root Traction Co., Hamilton, Mont.
MARKS, Lionel S. (1897; 1904) Asst. Prof. Mech. Engrg., Harvard University and for mail, 18 Lancaster St., Cambridge, Mass.
MARSHALL, Wm. Crosby (Junior, 1901) Asst. Prof. Desc. Geom. and Drawings, S. S. S., Yale University, and for mail, 201 Edwards St., New Haven, Conn.
McEVOY, Dermot (1906) Derby Rubber Co., Derby, Conn.
MEISSNER, Charles F. (Junior, 1901) 262 20th St., Brooklyn, N. Y.
MERRITT, Arthur A. (1907) 19 Bancroft Ave., Worcester, Mass.
MILLER, George H. (1906) Genl. Engr., The American Thread Co., 549 Main St., and for mail, 135 Lincoln St., Holyoke, Mass.
MOODY, Herbert A. (1901; Associate, 1905) Industrial Engr., Sandy Hill, N. Y.
MUNBY, Ernest J. (1906) Carl Junction, Mo.
MURRIE, John Lester (Junior, 1905) Asst. Mech. Engr., Ernest Flagg, Arch., 35 Wall St., and 104 W. 86th St., New York, N. Y.
ORD, Henry C. (1905) Chf. Engr., American Air Cleaning Co., and for mail, 209 13th St., Milwaukee, Wis.
OSTRANDER, Allen Edward (Associate, 1905) Asst. Mech. Engr., American Car and Foundry Co., 25 Broad St., and 146 W. 104th St., New York, N. Y.
PERKINS, G. Hawthorne (Associate, 1907) head of Textile Engrg. Dept., Lowell Textile School, Lowell, Mass.
PERKINS, George Howard (Junior, 1900) Supt. of Refineries, Warren Bros. Co., 93 Federal St., Boston, and 5 Irving Terrace, Cambridge, Mass.
PETTIS, Clifton Dancy (1905) Hewitt Mfg. Co., 303 Railway Exchange, Chicago, Ill.
PHILBRICK, H. S. (Junior, 1907) 707 Maryland Pl., Columbia, Mo.
PHUL, William von (1907) Ford, Bacon & Davis, Liverpool, London & Globe Bldg., New Orleans, La.
POST, George Adams, Jr., (Junior, 1906) Engr. Representative, Standard Coupler Co., 160 Broadway, New York, and for mail, Bronxville, N. Y.
PRINCE, John Walter (Associate, 1905) Vice Pres. and Treas., The Freeborn Engrg. & Constr. Co., 609 Scarritt Bldg., Kansas City, Mo

RICHARDS, Francis H. (1880) Life Member, Mech. Engr., Patents and Patent Law, Expert in Patent Causes, Prop. Machine, Model and Pattern Shops, Franklin Bldg., 9–15 Murray St., and for mail, Waldorf Astoria, New York, N. Y.

ROYLE, Vernon Elmer (Junior, 1905) Mech. Engr., John Royle & Sons, and for mail, 618 E. 28th St., Paterson, N. J.

SEWALL, M. W. (1899) Babcock & Wilcox Co., 85 Liberty St., New York, N. Y., and 222 4th Ave. W., Roselle, N. J.

SHIEBLER, Marvin (Junior, 1905) Mech. Engr., 278 Berkeley Pl., Brooklyn, N. Y.

SALTER, Thomas Fitch (1905;1907) 158 Grove St., Passaic, N. J.

SMITH, Cameron C. (1906) Pres. and Genl. Mgr., Union Steel Castings Co., Pittsburg, Pa.

SNOW, Walter B. (1898) Publicity Engr., 170 Summer St., Boston, and 29 Russell Ave., Watertown, Mass.

SULLIVAN, Lucien N. (1903) 29 W. 39th St., New York, N. Y.

TAGGE, Arthur C. (1901) 66 Macomb St., Monroe, Mich.

TAIT, Roderick H. (1904) Cons. Engr., Wright Bldg., and 1368 Granville Pl., St. Louis, Mo.

TOWLE, Wm. Mason (1887) Life Member, Supt. of Shops, Clarkson School of Technology, and for mail, 27 Main St., Potsdam, N. Y.

TROTZ, J. O. E. (1906) Cons. Engr., 20 Green Lane, Worcester, Mass.

TYLER, Chas. C. (1897) Engineers Club, 32 W. 40th St., New York, N. Y.

UNGER, John S. (1886) Cons. Engr., Kerr Murray Mfg. Co., Fort Wayne, Ind.

WOODBURY, C. J. H. (1880) Life Member, Secy., The Natl. Association of Cotton Mfrs., 45 Milk St., Boston, and for mail, 51 Baltimore St., Lynn, Mass.

WALLIS, James T. (1901) Supt. of Motive Power, Erie Division and Northern Central Railway, and 7 Trinity Pl., Williamsport, Pa.

WILLE, Henry Valentine (1900) Asst. to the Supt., Baldwin Loco. Wks., 500 N. Broad St., and 743 Corinthian Ave., Philadelphia, Pa.

WILLIAMSON, Wm. C. (1882) 12th St. and Valley Road, Oak Lane, Philadelphia, Pa.

WINSHIP, James G. (1891) Interntional Steam Pump Co, 114 Liberty St., New York, and for mail, 1248 Pacific St., Brooklyn, N. Y.

NEW BOOKS

Concrete Engineers and Contractors Pocketbook. Prepared by the Editors of "Concrete Engineering," assisted by William F. Tubesing. *The Technical Publishing Co., Cleveland. 1907.* 12mo, 192 p.

Contents: Standard Data for Designing Engineering; Tables of Recent Tests; Special Tables for Computing Beams; Extracts from Standard Works.

Standard Polyphase Apparatus and Systems. By Maurice A. Oudin. *D. Van Nostrand & Co., New York. Fifth Edition, 1907.* 8vo, 369 p. $3.

Contents by chapter headings: Definitions of Alternating Current Terms; Generators; Generators (concluded); Induction Motors; Induction Motors (concluded); Synchronous Motors; Transformers; Rotary Converters; Motor Generators, Frequency Changes, and Other Converting Apparatus; Switchboards and Station Equipment; Lightning Protection and Line Construction; Two-Phase System; Three-Phase System; Choice of Frequency; Relative Weights of Copper for Various Systems; Calculation of Transmission Lines.

Stationary Engineering. By Joseph G. Branch, Chief of Dept. of Inspection Boilers and Elevators *The National Equipment Co., St. Louis. Second Edition, 1907.* 8vo, 1005 p. $3.50.

Contents by Chapter Headings: Boilers; Combustion; Boiler; Installation; Boiler Accessories; Boiler Management; Leading Types and Specifications of Boilers; Furnace Attachments; Boilers for Heating Purposes; Boiler Trials; The Steam Engine; Governors; Valve Gears; Condensers; Compound Engines; Pumps; Types and Description of Steam Pumps; Electricity and Magnetism; Dynamos and Motors; Operation of Dynamos and Motors; Elevators; The Steam Engine Indicator; Mechanical Refrigeration; Hoisting and Portable Machines; Laws and Regulations for the Inspection of Boilers and Licensing of Engineers and Firemen; Electricity; The Steam Turbine; Tables.

A Treatise on Hydraulics. By William Cawthorne Unwin. *Adam & Charles Black, London. 1907.* Demy, 8vo, 327 p. 12s. 6d. net.

Contents by Chapter Headings: Units of Measurement; Properties of Fluids; Distribution of Pressure in a Liquid Varying with the Level; Principles of Hydraulics; Discharge from Orifices; Notches and Weirs; Statics and Dynamics of Compressible Fluids; Fluid Friction; Flow in Pipes; Distribution of Water by Pipes; Later Investigations of Flow in Pipes; Flow of Compressible Fluids in Pipes; Uniform Flow of Water in Canals and Conduits; Gauging of Streams; Impact and Reaction of Fluids. *Appendix:* Functions of Numbers from 0.1 to 100 Velocity and Head; Slope Table; Table to facilitate Calculations on Pipes; Discharge of Pipes at Different Velocities in Gallons per Hour; Discharge of Pipes at Different Velocities in Cubic Feet per Second; Loss of Head in New Cast-Iron Pipes; Loss of Head in Incrusted Cast-Iron Pipes.

The International Mining Manual. 15th Annual. Edited by Alexander R. Dunbar. *Western Mining Directory Co., Denver, Colo. 1907.* 4to, 513 p.

Contents: The Principal Operating Metal Mines, Mills, Smelting, and Refining Plants of the United States, Mexico and Canada; and Coal Mines of the Western States, Mexico, and Canada. Engineering Section: Consulting Mining and Metallurgical Engineers and Mining Geologists and Mine, Mill and Smelter Managers and Superintendents, with degrees, etc.

Geological Survey of Western Australia. *Bulletin 23, 24 and 25. (With maps.) 1906.*

New England Water Works Assoc'n. *Journal. Vol. 21. No. 2. June 1907.*

Brooklyn Engineers' Club. *Proceedings. Vol. 10. 1906.*

Proceedings of American Railway Master Mechanics' Assoc'n. *Vol. 40. Chicago. 1907.*

American Institute Electrical Engineers. *Transactions. Vol. 25. 1906.*

Canadian Society Civil Engineers. *Transactions. Vol. 20. Parts 1 & 2. 1906.*

Civil Engineers of Ireland. *Transactions. Vol. 33. 1907.*

Association des Ingénieurs de Gand. *Tome 6 No. 1. 1907.*

CANDIDATES FOR MEMBERSHIP

Record of Qualifications, Engineering Experience and References

This list should be treated as confidential and is subject to inspection by members of the Society only. The names are those of candidates whose applications have been approved by the Membership Committee and the Council. The names appear in the same order as on the ballot sent to the voting membership, closing November 28, 1907.

TO BE VOTED FOR AS MEMBERS

JAMES GARNETT BASINGER, 45 Broadway, New York, N. Y. Born, Savannah, Ga., May 1870. Education: University of Georgia, M. A. civil and mining engineer, 1890; special course at college in chemistry, metallurgy and assaying, 1888–1890. Other engineering work: Associated with hydraulic gold mining and stamp mills in Northern Georgia; general surveying and civil engineering in the City of New York, 1891–1896; Department of Docks, New York, on plans and specifications for piers, cribs, etc., examinations of plans for steel shed coal bins, derricks, etc., 1896–1905; appointed assistant engineer in responsible charge of design and of all construction work on North River from Pier A to West 44th St., October 1896; engineer for G. B. Spearin, 1905–1906, in responsible charge of construction of Dry Dock 4, New York Navy Yard, directed methods of work, designed, selected, installed and operated all plant; May 1906 to date, consulting engineering, design installation, and operation of a dredging plant at Far Rockaway, L. I.; Member American Society of Civil Engineers. Present position, Consulting engineer.

References: A. L. Bowman, H. N. Covell, W. F. Hunt, Augustus Smith, J. S. Foster.

ARTHUR K. BECKWITH, Dowagiac, Michigan. Born, Michigan, October 1861. Apprentice: Estate of P. D. Beckwith, molding machinist's trade 1877. Other engineering work: Reconstruction and superintendence of the Round Oak Stove Works, Dowagiac, Mich., including converting transmission from mechanical to electrical. Since 1877, with the Beckwith Estate in all the various capacities pertaining to its mechanical business, designed and superintended erection of all their buildings and machinery, designed all their manufactured goods since 1895; general charge of water power plant for city lighting; Vice President, Ameri-

can Foundrymen's Association. Present position, General Superintendent, Round Oak Stove Works, Dowagiac, Mich.

References: Richard Moldenke, James W. Lyons, Jos. Leon Gobeille, Wm. S. Love, Arthur West, Irving R. Reynolds.

HARRY BENTLEY, Whitehaven, England. Born, Morley, Yorkshire, England, February 1864. Education: Yorkshire College, Leeds, Yorkshire. Apprentice: Geo. Bentley, Morley, engineer and iron founder, stationary engineer, etc., 1879–1885. Drafting room: Geo. Bentley, 1883–1884. Shop experience: Geo. Bentley, erecting shop foreman, 1888–1890. Other engineering work: Works manager, Geo. Bentley, 1890–1893; manager of engineering department for W. Thomlinson-Walker, Victoria Iron Works, 1893–1895; Works Manager, Ashwell & Nesbit, Ltd., Leicester, 1895–1897; Chief Engineer, Freehmann Week & Co., Ltd., Rochester, Kent, 1897–1899. Present position, From 1899 to present time, manager, Lowca Engineering Co., Ltd., Whitehaven, England, builders of locomotives, iron and steel works plant.

References: Axel Sahlin, By-Law 2, Foreign.

HOWARD LAWRENCE BODWELL, Monessen, Pa. Born, Georgetown, Mass., March 1876. Education: Mass. Institute of Technology, S. B., 1898. Apprentice: Brown & Sharpe Mfg. Co., Providence, R. I., July-October, 1897, during vacation. Drafting room: Howe Scale Co., Rutland, Vt., John A. Mead Mfg. Co., New York; American Sheet Steel Co., Pittsburg, 1898–1902. Shop experience: Each of the above places. Other engineering work: At Rutland assisted mechanical engineer in various improvements of the plant; John A. Mead Mfg. Co., charge as erecting engineer of installation of machinery in various cities; American Sheet Steel Co., erection of machinery, buildings and in testing; appointed resident engineer in charge of the improvements of Aetna-Standard Works, Bridgeport, Ohio, and Cambridge Works for the engineering department of the American Sheet Steel Co.; charge of foundation work, erection of buildings, and installation of various rolling mill machinery and furnaces; designed warehouse and offices; installed 5000 h.p. water purifying plant, 1902–1904 continuing work until combination of American Sheet Steel and American Tin Plate Companies. Present position: Master mechanic of National Works, American Sheet and Tin Plate Co., supervision of all machinery and power, installation of new machinery, execution of original designs.

References: Sumner B. Ely, John J. Muir, Peter Schwamb, W. F. Rust, C. W. Bennett.

JAMES CHURCHILL BOYD, 10 Bridge St., New York. Born, St. Louis, Mo., August 1871. Education: Mass. Inst. of Technology, three years. Other engineering work: Bangor & Aroostook R. R., rodman, inspector of bridges and masonry, engineer in charge of location and construction, 1891–1895; chief engineer, Patten & Sherman R. R., 1895; constructing sewerage system, Houlten, Me., 1896; assistant engineer, surveys and plans for water works, Lincoln, Mass., 1897; assistant engineer, Boston Elevated Ry. Co., preliminary studies, estimates and designs for elevated system, 1897–1899; division engineer, charge design and construction, Charlestown, Atlantic Ave., and subway division, including terminal station and shops, 1901; charge maintenance of structure, track, signals, buildings, etc., 1901–1902; engineer in charge new construction, Bangor & Aroos-

took R. R., and engineer of track, bridges, buildings and signals, 1902–1903; Westinghouse Church Kerr & Co., charge of various work, design and construction of arsenic mine reduction plant, transmission for L. I. R. R., estimates and reports on proposed subway systems for New York and Brooklyn; design and construction heavy steel casting foundry; designs for coal handling apparatus, etc., 1903–1907; mechanical engineer Westinghouse Church Kerr & Co., general supervision of design and construction of mechanical work, layouts, power houses, foundries, electric railways, etc., to date. Present position: Consulting mechanical engineer, Westinghouse Church Kerr & Co.

References: George Gibbs, George B. Caldwell, Henry R. Kent, F. A. Scheffler, Walter C. Kerr.

ARTHUR JAMES BRIGGS, Smith-Premier Typewriter Co., Syracuse, N. Y. Born, Bristol, N. Y., August 1872. Education: Four years Cornell University; special mechanical engineering course. Other engineering work: Sioux City Traction Co., Sioux City, Ia., engineer in charge of power house, line and track construction, 1897–1898; Marvin & Caslor, Canastota, N. Y., carrying on experimental work for the American Mutoscope and Biograph Co., 1900–1903; Smith-Premier Typewriter Co., designer, later in charge of experimental work and tool design, 1904 to present time; made chief engineer, July 1906. Present position, Chief engineer, Smith-Premier Typewriter Co.

References: John E. Sweet, John H. Barr, Alex. T. Brown, A. W. Smith, D. S. Kimball, Geo. H. Shepard.

JOHN ALEXANDER BRITTON, 925 Franklin St., San Francisco, Cal. Born, Boston, Mass., October 1855. Drafting room: Five years in Oakland, Cal., in preparation of designs of gas and electric apparatus, buildings and installation of steam and gas plants. Shop experience: In meter repair and machine shops of Oakland Gas, Light and Heat Co., 1874–1888, intermittently. Other engineering work: Oakland Gas, Light and Heat Co., 1874–1904, engineer of manufacture and distribution in gas department, operation and distribution in electric department; consulting engineer for companies on Pacific coast; gas apparatus, new checker brick methods in water gas sets; designed and installed first high pressure gas distribution system; designed and erected complete steam plant for electric generation: 15 years engineer of gas and electric departments, charge and supervision of all the construction work and daily operation of the plants. Present position, President, Pacific Gas and Electric Co., general manager, Cal. Gas & Elec. Corporation.

References: E. C. Jones, O. N. Guldlin, E. A. Rix, R. S. Moore, F. G. Baum.

CHARLES UNDERWOOD CARPENTER, 400 Broadway, New York, N. Y. Born, Cambridge, Ind., January 8, 1872. Education: Princeton University, B. A., 1893. Shop experience: Wide practical and general shop experience and management in the works of National Cash Register Co., Dayton, Ohio; and Herring-Hall-Marvin Safe Co., Hamilton, Ohio. Other engineering work: National Cash Register Co., head of Inspection Department, later appointed one of four factory managers in direct charge of 3000 men; later head of Labor Department, member Executive Board of Directors. Prepared a series of articles covering Factory Management and System, The Engineering Magazine; charge as Factory Manager of factories Herring-Hall-Marvin Safe Co., Hamilton, Ohio, 1903; these

were thoroughly reorganized; appointed Vice-President of the company. Present position, President, Herring-Hall-Marvin Safe Co., since January, 1906.

References: Charles D. Montague, E. A. Deeds, Robert I. Clegg, R. D. Lillibridge, F. W. Taylor.

FRANK M. COFFIN, 131 Liberty St., New York. Born, Nantucket, Mass., November 1866. Education: College of the City of New York; two years Cooper Institute. Apprentice: Whittier Elevator Co., 1887–1892, machine design and general drafting. Drafting room: Designing of elevator machinery and layouts of work for Whittier Elev. Co.; for two years in business in New York; with D. H. Darrin Co., New York, since August 1897. Shop experience: Whittier Elevator Co., and D. H. Darrin Co., New York. Other engineering work: Consulting engineer, Automatic Switch Co., New York, designed and constructed automatic electric controlling devices now building for use on electric motors, since January 1901. Present position, Chief mechanical engineer, D. H. Darrin Co., and Automatic Switch Co., designing and superintending the construction of elevator mechanisms and automatic controlling devices.

References: David H. Darrin, S. D. Collett, Paul H. Grimm, Louis K. Comstock, Wm. M. Dollar.

FREDERICK ALBERT COLEMAN, J. B. Smith Foundry Supply Co., Cleveland, Ohio. Born, Oconto, Wisconsin, February 1869. Education: Case School of Applied Science, 2½ years; Lehigh University, C. E. 1892. Other engineering work: With the Stanwix Engineering Co., Rome, N. Y., 1892–1893, hydraulic and sanitary engineering work; engineering office at Black Rock, Ark., 1894; The Stanwix Engineering Co. Rome, N. Y., 1895–1898, in responsible charge water works, sewers, etc., Pawling, Rome and Cazenovia, N. Y. and miscellaneous engineering work; city engineering, Rome, N. Y. 1898–1900, paving, sewers, bridges, street railroad work; general superintendent Valley Coal & Coke Co. and Belington Northern R. R. Co., Belington, W. Va., operating mines and railroads, heavy railroad, mine construction, buildings, bridges, etc., 1901–1904. Present position; Vice President and foundry engineer, J. D. Smith Foundry Supply Co., 1904 to date.

References: A. W. Foote, C. J. Caley, H. M. Lane, B. V. Nordberg, Ludwig Herman.

ROBERT EDWARD CRANSTON, Sacramento, Cal. Born, St. John, Mich., June 1873. Education: Four years, Michigan School of Mines. Drafting room: Hull and machine design for Ashburton Mining Co.; eight years as engineer and the last three as manager. Shop experience: Designed, built and operated shop at Folsom for Ashburton Mining Co., eight years; designed, built and operated shop for Marysville Gold Dredging Company, two years. Other engineering work: Design, construction and operation of gold dredges; examination and testing of gold and other mineral deposits and equipment for mining operations; rebuilt Ashburton gold dredges; designed and built gold dredges at Sailor Bar; now building one at Folsom from own designs for Ashburton Mining Co.; charge of construction of two dredges for Marysville Gold Dredging Co. Present position, Manager Ashburton Mining Co.; engineer, New England Building Exploration Co.; manager Marysville Gold Dredging Co.

References: G. L. Holmes, C. P. Wieland, Thos. Morrin, E. A. Rix, W. A. Doble, W. S. Noyes, H. J. Small.

FRANK I. ELLIS, 2312 Farmers Bank Bldg., Pittsburg, Pa. Born, Heathcote, Victoria, Australia, June 1863. Education: Five years High School, two years Leopold College. Apprentice: Langlands Foundry, Melbourne, Australia; Patt., Mach. and Fdy., mining, marine and general machinery, 1879–1885. Drafting room: Julian Kennedy M.E., 1895; Schoenberger Steel Co., 1896; Union Fdy., Pittsburg, six months, 1897; Carnegie Steel Co., City Mills, about two years. Shop experience: Pattern shop and machine shop and drawing room, Australia and America. Other engineering work: Last nine years with the United Eng. and Fdy. Co., charge of the designing of all machinery built in that time; at Carnegie Steel Co., charge of designing, installing and operating of new machinery; Union Fdy. and Mch. Co., Pittsburg, and Clott & Meese San Francisco, prior to 1895, charge of the designing of different types of land and marine machinery. Present position, Chief engineer, United Eng. and Fdy. Co., Pittsburg, Pa.

References: T. J. Bray, F. V. McMullen, Chester B. Albree, C. W. Bray, W. E. Snyder.

ALBERT GEORGE ELVIN, Franklin Railway Supply Company, Franklin, Pa. Born, North Vernon, Ind., February 1865. Apprentice: Indianapolis, Peru and Chicago Railroad, boiler maker and machinist, 1883–1888. Drafting room: Wabash and Panhandle, 1885–1890. Shop experience: Peru, Ind., I. P. & C. R. R., Chicago & Erie and Northern Pacific Railway, 1883–1892. Other engineering work: Last 15 years, general foreman, Chesapeake & Ohio R. R.; master mechanic on the Grand Trunk and Delaware, Lackawanna & Western Railroads. Present position, Mechanical Manager, Franklin Railway Supply Co., locomotive and car equipment.

References: B. Haskell, Wm. G. Shepherd, Jas. McNaughton, Geo. W. Wildin, E. V. Sedgwick.

WILLIAM PENN EVANS, 306 Lumber Exchange, Portland, Ore. Born, Bridgeport, Pa., October 1856. Education: Polytechnic of Pennsylvania. Apprentice: Machinist, Baldwin Locomotive Works, 1872. Drafting room; In charge of drawing room, Baldwin Locomotive Works, 18 years. Shop experience: Night Superintendent, Baldwin Locomotive Works, six months. Other engineering work: Representative Baldwin Locomotive Works; Louisiana Purchase Exposition; Lewis and Clarke Exposition. Present position, Northwestern representative, Baldwin Locomotive Works, Portland, Ore.

References: S. M. Vauclain, G. Lanza, Coleman Sellers, Jr., H. V. Wille, H. DeH. Bright.

WALTER G. FRANZ, Union Trust Building, Cincinnati, Ohio. Born, St. Louis, Mo., July 1875. Education: Missouri State University, B. S., in M. E., 1899. Apprentice: The American Arithmometer Co., St. Louis, Mo.; Terminal R. R. Assn., St. Louis, Mo., electrical department. Drafting room: Drafting room of the Missouri River Commission, St. Louis, Mo. Other engineering work: Recorder on field work for the Missouri River Commission; inspector Bell Telephone Co., St. Louis, Mo.; Struthers-Wells Co., Warren, Pa., estimating and designing 1899–1904; consulting engineering work in conjunction with Gustave W. Drach, architect, Cincinnati, Ohio, designed and superintended the installation of the mechanical equipment of eleven large office and power buildings in Cincinnati, central heating and lighting plant, Miami University, Oxford, Ohio; mechanical

equipment including power plant for Chas. Moser Paint Co., Cincinnati; heating, electric lighting and plumbing for Filter House, Cincinnati Water Works, Cincinnati; mechanical equipment including power plant for Day & Night Tobacco Co., Cincinnati; mechanical equipment including power plant, American Diamalt Co., Cincinnati, for new auditorium and administration building for Miami University; at present laying out the mechanical equipment for Tobacco factory of Lovell & Buffington, Covington, Ky., etc. Present position: Consulting engineer.

References: Walter Laidlaw, G. W. Galbraith, N. H. Miller, Thomas Elliot, J. B. Stanwood.

ALEXANDER S. GARFIELD, 67 Avenue de Malakoff, Paris, France. Born, Detroit, Michigan, March 1866. Education: Mass. Inst. of Technology, S.B. Four years mechanical engineering; One year (Post graduate) Civil Engineering. Other engineering work: Thomson Electric Welding Co., Paris 1889, London 1890; Power and Mining Dept. Thomson-Houston and General Electric Companies, West Lynn, 1891–1893, design and manufacture; from 1893, design and execution of all electrical traction plant of Paris-Orleans, Western Railway and the major part of Paris-Metropolitan railways; at present design and execution of electrical power station near Paris of 100 000 h.p. 5000 and 8000 kw. Curtis turbo-alternators, substations etc. Present position: Chief Engineer, Cie Francaise pour l'Exploitation des Procedes Thomson-Houston; consulting engineer of Cie d'Electricité Thomson-Houston de la Mediterranée; consulting engineer of the General Electric Company of New York.

References: Messrs. C. W. Rice, W. B. Potter, A. L. Rohrer, E. M. Hewlett and C. D. Haskins.

ARTHUR HUGH GOLDINGHAM, 457 W. 123d St., New York, N. Y. Born, Worcester, England, June 1868. Education: Private schools, Malvern, England. Apprentice: Samuelson & Sons, Banbury, England, machinist and erecting, 1888–1892. Drafting room: One year, Samuelson & Sons; three years De La Vergne Machine Co., New York. Shop experience: R. Hornsby & Sons, Crantham, England, erecting and inspecting, 1892–1895. Other engineering work: De La Vergne Machine Co., New York superintending, testing, inspecting, designing, 1895–1907; Author: Oil Engines, 1900, Gas Engine in Principle and Practice, 1907. Present position, With De La Vergne Machine Co., New York.

References: Chas. E. Lucke, C. W. Whiting, J. C. Winship, J. H. Jowett, L. C. Doelling.

ROBERT HALSEY HENDERSON, Westinghouse Lamp Co., Bloomfield, N. J. Born, Keokuk, Iowa, August 1876. Education: Northwestern University, Ph.B. 1902. Drafting room: Westinghouse Electric & Mfg. Co., General charge of shop drafting. Shop experience: Western Electric Co., Chicago, Ill. 1892–1893, machine tools and in lamp department, Chicago Edison Co., McFell Electric Co., Henderson Electric Co., Chicago, Ill., 1893–1898, general mechanical and electrical work. Other engineering work: Designed and patented Henderson boring machine, 1895; Henderson Insulator, 1896; general engineering, erecting work, Evanston Electric Illuminating Co., Evanston, Ill., 1899–1902, engineering on arc lamp, Westinghouse Electric & Mfg. Co., E. Pittsburg, Pa., two patents issued, 1902; assistant superintendent, W. E. & Mfg. Co., Newark, N. J., in charge of building and power plant, erection and maintenance, factory

engineering in general, 1903–1906. Present position, Supt. Westinghouse Lamp Co., Bloomfield, N. J. Completion of factory buildings and design of factory equipment; manufacture of incandescent lamps.

References: E. M. Herr, Henry R. Kent, P. A. Lange, Tracy Lyon, J. W. Thomas.

HERBERT T. HERR, 1529 Gaylord St., Denver, Colorado. Born, Denver, Colorado, March 1876. Education: Yale University, Ph.B., 1899. Apprentice: C. & N. W. Ry. Shops, Chicago, Ill.; D. & R. G. shops, Denver, Col., mechanical department; 1895–1900, as special machine apprentice. Shop experience: D. & R. G. R. R., Denver, Colorado, 1900–1901; master mechanic C. G. W. Ry., St. Paul, 1901–1902; master mechanic, A. T. & S. F. Ry., Fort Madison, Iowa, 1902–1903; general master mechanic Norfolk & Western R. R., Roanoke, Virginia, 1903–1905. Other engineering work: Assistant to vice-president, D. & R. G. R. R., Denver, Colorado, 1905; general superintendent D. & R. G. R. R., Denver, 1906; development, Duquesne Mining & Reduction Co.'s properties, Duquesne, Arizona; installation power equipment; transportation equipment; development of present braking equipment, Westinghouse Air-Brake Co.; Car, locomotive and shop construction, in R. R. experience. Present position, Vice-president and general manager Duquesne Mining and Reduction Co.

References: Geo. Westinghouse, H. H. Westinghouse, W. M. McFarland, G. M. Basford, W. W. Nichols.

ALEXANDER LOUIS HOERR, 1011 McCleary St., McKeesport, Pa. Born, Pittsburg, Pa., June 1873. Education: Western University of Pennsylvania, M. E., 1895. Drafting room: Jones & Laughlin Steel Co., power transmission and rolling mill machinery, and open hearth and rolling mill heating furnaces, 1895–1898; Lackawanna Steel Co., gas producer and regenerative furnaces design, Dec. 1903 to Mar. 1904; Jones & Laughlin Steel Co., design of engine and boiler installations, 1904–1905. Other engineering work: Jones & Laughlin Steel Co., assistant constructing engineer, 1898–1900; Jones & Laughlin Steel Co., master mechanic, continuous bar mills, 1900–1901; Jones & Laughlin Steel Co., assistant superintendent, department of steam engineering, 1901–1903; Fort Pitt Engineering and Construction Co., mechanical engineer July-December 1903; National Tube Co., design and construction of new plant for Republic dept., including buildings, mills, furnaces, etc. for production of puddled and refined charcoal skelp, April 1905; The National Rolling Mills and Monongahela Furnaces and Steel Works, added with charge of all engineering and office and field construction works, March-September 1906. Present position, Chief engineer, Monongahela Furnaces and Steel Works, and National Rolling Mills, McKeesport, Pa., and Republic department, Pittsburg, of the National Tube Co., supervising the design and construction of the blast furnaces, mills, etc., at above plants.

References: R. T. Stewart, R. Crooker, Jr., C. B. Connelley, E. V. Wurts, H. R. Cornelius.

FREDERICK JEROME HOXIE, Inspector Factory Mutual Ins. Co's., Phenix, R. I. · Born, Phenix, R. I., May 1871. Education: Mass. Inst. of Technology B. S., 1892. Drafting room: Experimental work on vacuum bleaching process, designed and made drawings for International Kier Mfg. Co., Providence, R. I., 1892–1893. Shop experience: Electrical contractor Phenix, R. I.; electric mill

lighting plants, Crompton Co., R. I.; Pocasset Mfg. Co., Fall River, Mass.; Eagle Mills, Woonsocket, R. I.; Hope Co., Phenix and Hope, R. I. and others, 1895–1903. Other engineering work: Designed and installed experimental vacuum and pressure bleachery, Cranston, R. I., 1892–1893; designed and manufactured electrical switches, switchboards, slate cabinets, etc., 1900–1903; designed and erected electrical advertising devices, Hall & Lyon, Providence, R. I., 1903; measurements of electrical earth connections and conductivity of hose streams, 1906–1907. Present position, Inspector Factory Mutual Fire Insurance Companies, Boston, Mass., laying out and approving protection for factories and general inspection and experimental work.

References: John R. Freeman, L. H. Kunhardt, E. D. Pingree, H. A. Burnham, J. B. Siner.

HOWARD MAXWELL INGHAM, 76 Dwight Place, Englewood, N. J. Born, Philadelphia, Pa., April 1877. Education: Sheffield Scientific School, Yale University, Ph.B., and one year Post Graduate work, 1897. Apprentice: Special, steam engine building, Southwark Foundry and Machine Co., 1898–1899. Drafting room: Southwark Foundry and Machine Co., drawing-room about five months from November 1899, on theoretical steam engine diagrams of all sorts, valve settings, and various engine drawings. Shop experience: Assistant to superintendent to devise and develop system for keeping track of all the work through the shops, patterns, castings, forgings, machine work and purchases; department of costs and estimates, one year. Other engineering work: M. W. Kellogg & Co., & Co., N. Y., superintendent of a new manufacturing plant, high pressure and low pressure pipe and fittings, 1904–1906; assisted in design and building of new plant in Jersey City, including foundry and pattern shop; moved machinery and stock to new plant and started operations March 1906; organized the new plant and superintended same to date; during this period the company made several extensions to the plant, including increase of power capacity to take care of new process of manufacture,. Present position, Superintendent M. W. Kellogg Co., New York and Jersey City.

References: Frederick B. Hall, Josiah Harmar, Thomas H. Mirkil, George A. Orrok, Frank W. Bunn.

HEBER CLYDE INSLEE, 50 Spruce St., Newark, N. J. Born, Newark, N. J. September 1871. Education: Princeton University, C.E., 1893. Drafting room: Babcock & Wilcox Co., 1894–1896. Pond Machine Tool Works, January to July 1898; Singer Mfg. Co., tool room, 1898–1899. Other engineering work: Babcock & Wilcox Co., 1899 to date; engaged in designing heavy hydraulic machinery, special machine tools, forging dies etc., and supervising their construction; perfecting the hydraulic system and other engineering work in connection with their Bayonne plant, created since 1900. Present position, Engineer on plant work, Babcock & Wilcox Co., Bayonne, N. J.

References: M. W. Sewall, C. P. Higgins, Wm. A. Jones, W. D. Hoxie, Edmund Mills.

JOHN A. LE BLOND, 4609 Eastern Ave., Cincinnati, O. Born, Covington, Ky., June 1874. Apprentice: Four years with R. K. LeBlond Machine Tool Co., operating shapers, planers, lathes, milling machines, gear cutters, drilling machinery, bench and floor work, processes in manufacture of special machinery

& machine tools. Drafting room: With R. K. LeBlond Machine Tool Co. Shop experience: R. K. LeBlond Machine Tool Co., two years as engine lathe operator, two years foreman of lathe operators, two years general foreman of all machine operators, including tool room. Other engineering work: Seven years general superintendent of the R. K. LeBlond Machine Tool Co. plant, employing 350 men, and 20 foremen. Present position, Superintendent, R. K. LeBlond Machine Tool Co., Cincinnati, O.

References: William Lodge, Richard K. LeBlond, F. A. Geier, Jas. C. Hobart, Henry F. Frevert, Walter Laidlaw.

FRANCIS V. T. LEE, 925 Franklin St., San Francisco, Cal. Born, Winchester, England, August 1870. Education: College Communal, Boulogne, S.M. France, and four years Leland Stanford Jr. University, Cal., B.A. in Elec. Eng., 1897. Drafting room: Preliminary sketches for laying out stations and work. Other engineering work: Canadian Pacific Railway, secretary to Chief of Construction and in charge of forwarding material, 1887–1890; Manhattan Elec. Light Co., New York, assistant supt., 1892–1893; Assistant Engineer in charge of Construction and Engineering, Pacific Coast District, Stanley Elec. Mfg. Co., 1897., manager and engineer, designed in part, number of plants installed on Pacific Coast, supervised construction etc., 1898; Vice-President and Gen. Mgr., John Martin & Co., Elec. Engrs. and Contractors, 1899; Assistant general manager, Stanley Elec. Mfg. Co., Pittsfield, Mass., 1901; Pacific Coast manager, Stanley Elec. Mfg. Co., Northern Elec. Mfg. Co., Fort Wayne Elec. Works and Sprague Elec. Co., 1906; Assistant to Pres., Pacific Gas and Electric Co., controlling principal gas and electric systems of Central Cal., 1906; in charge of engineering and construction departments electric, mechanical and hydraulic. Present position: Supervising all engineering and operating work of operation and maintenance and distribution depts. Mem. Am. Inst. Elec. Engrs., Am. Electro Chem. Society, Pacific Coast Elec. Trans. Ass'n, Pacific Coast Gas Ass'n, Assoc. Mem. Inst. Elec. Engrs., London.

References: E. C. Jones, Geo. J. Henry, Dr. F. A. C. Perrine, Calvin W. Rice, Harris J. Ryan D. B. Rushmore, D. S. Kimball, W. R. Eckart.

WILLIAM FLOYD LEE, C. W. Hunt Co., West New Brighton, S. I. Born, Abingdon, Va., September 1873. Education; Virginia Mechanics Institute, three years. Drafting room: Richmond Locomotive Works, 1891–1894; Cardwell Mch. Co., chief draftsman, 1894–1899. Shop experience: Cardwell Mch. Co., assistant in charge of shop during absence of superintendent, designed automatic machinery, pumps, oil and pulp mills, erected oil mills and tested steam power plants. Other engineering work: Petersburg Iron Works, in charge of marine engine for U. S. Light Ship, 1899–1900; Wm. R. Trigg Co., in charge of boiler and propeller design, engines and auxillaries for U. S. revenue cutter and charge of engine room tests on trial trips, 1900–1903; Tennessee Coal, Iron and R. R. Co., Assistant engineer on design and construction of blast furnace plant, open hearth plant, bessemer converter plant, bloom and rail mills and appurtenances, power plants and mill buildings, 1903–1905. Present position, Preliminary engineer, C. W. Hunt Company.

References: C. W. Hunt, G. S. Humphrey, Daniel Ashworth, David Shirrell Arthur Scrivenor, Carl J. Mellin, C. W. Barnaby, W. F. Hunt.

WILLIAM STATES LEE, Southern Power Co., Charlotte, N. C. Born, Lancaster, S. C., January 1872. Education: Four years South Carolina Military Academy, Charleston, S. C. Drafting room: Greenwood-Anderson & Western Railway, five months. Other engineering work: Greenwood-Anderson & Western Railway, three months transitman, resident engineer on construction, 1896–1897; Anderson Water Light and Power Co., Anderson, S. C. resident engineer, charge of heavy masonry construction, erection and installation of hydraulic and electrical machinery, construction of transmission line, started plant in operation March-Dec. 1897; Pickens Railway, resident engineer on construction, December 1897 to March 1898; U. S. Engineering Department, assistant engineer on coast defense, work on forts around Charleston Harbor and fort on south side Port Royal entrance, assisted in mining Charleston Harbor, March-Nov. 1898; Columbus Power Co., Columbus, Ga., 8000 h.p. hydro-electric development, construction of 27 000 spindle fine yarn mill, resident engineer for Company, 1898–1901, chief engineer, 1901–1903; chief engineer Catawba Power Co., Charlotte, N. C. March 1903 to present time, chief engineer, Southern Power Co. (owners of The Catawba Power Co.), Charlotte, N. C., engaged in design and construction and operation of Southern Power Co. system, two hydro-electric plants in operation aggregating 50 000 h.p., two plants under construction aggregating 70 000 h.p. Present position, Chief engineer, Southern Power Co., Charlotte, N. C.

References: N. W. Thompson, F. S. Tucker, D. B. Rushmore, F. A. C. Perrine, C. E. Waddell, J. H. Felthousen.

JOHN RUTHERFORD MCGIFFERT, 302 Lake Ave., South Duluth, Minn. Born, Hudson, N. Y., March 1869. Education: Williams College, A. B., 1890; University of the City of New York, L.L.D., 1892. Shop experience: Clyde Iron Works, since 1902. Other engineering work: Engaged practice of patent law, 1893-1902; latter part of period 1901–1902 devoted to study of "steam-logging" and design and construction of "McGiffert steam log loader;" in charge of designing and constructing of steam logging machinery for Clyde Iron Works since Sept. 1902; designed "McGiffert loader," "rapid loader," "the Clyde steam skidder" and redesigned "Decker steam loader;" designed and constructed number of special steam machines for handling logs and other forest products. Present position, Secretary, Clyde Iron Works, Duluth, Minn.

References: Spencer Miller, Ralph Sprado, T. W. Hugo, Alfred Marshall, Fred M. Prescott.

CHARLES KING MALLORY, Solvay Process Co., Syracuse, N. Y. Born, Jackson, Tennessee, August 1875. Education: Four years U. S. Naval Academy; commissioned asst. engineer, U. S. N., 1897; ensign, 1899; Lieutenant, (J.G.), 1900; lieutenant; 1902. Apprentice: Two years at sea as cadet engineer on board U. S. S. Minneapolis, general duties as engineer officer, 1895–1897. Other engineering work: Cadet engineer, U. S. N., U. S. S. Minneapolis, 1895–1897; assistant engineer, U. S. S. Brooklyn, 1897–1898; assistant engineer, U. S. S. Minneapolis, 1898; assistant engineer, U. S. S. Oregon, 1898–1899; chief engineer, U. S. S. Manila, 1899–1900; course at U. S. Torpedo School, Newport, R. I., 1901; assistant inspector of machinery for U. S. Navy at Works of Newport News Shipbuilding and Dry Dock Co., 1901–1902; chief engineer, U. S. S. Detroit, 1902–1903; superintendent of steam engine exhibits and member of International Jury of Awards for Machinery Dept., Louisiana Purchase Exposition, 1904; assigned

to duty, Bureau of Steam Engineering, Navy Dept., 1904–1905; Secy-Treas., American Society Naval Engineers, 1905; managing engineer, Robins Conveying Belt Co., New York, 1905–1907. Present position, engineer of construction, Solvay Process Co., 1907.

References: Geo. W. Melville, Frederick Sargent, C. Kemble Baldwin, A. B. Proal, Jr., C. L. Griffin, W. H. Blauvelt.

CHRISTIAN WILLIAM MARX, Altas Engine Works, Indianapolis, Ind. Born, St. Louis, Mo., November 1865. Education: Washington University, 1887: one year at Munich, Germany. Other engineering work: Assistant superintendent Morden Frog and Crossing Wks. Chicago, 1887–1890; Supt. Indianapolis Frog & Switch Works, 1890–1891; professor of mechanical engineering, University of Missouri, 1891–1901; Dean of engineering department, University of Cincinnati 1901–1905; chief engineer L. Eid Concrete Steel Co., 1905–1907; at present consulting engineer Atlas Engine Works; consulting engineer for Joseph Bros. Co. cotton mill at Cin.; consulting engineer on power plant of Sinton Hotel, designed and supervised installation of complete heating and ventilating plant; consulting engineer for several architects in Cincinnati 1901–1907 on power and heating plants and concrete steel buildings. Present position, Consulting engineer, Atlas Engine Works.

References: H. E. Troutman, John A. Bechtel, G. W. Galbraith, Walter Laidlaw, Henry B. Prather, Wm. H. Bryan.

JOSEPH MERRITT, 315 Pearl St., Hartford, Conn. Born, Greenwich, Conn., February 1868. Apprentice: Port Chester Bolt & Nut Co., as machinist, 1886–1889; automatic machinery for making bolts and nuts. Drafting room: Pratt & Whitney, Tools and fixtures, 1889–1891; Leland, Faulconer & Norton, Detroit, Mich., type setting machinery, 1892–1894; Nat. Cash Register Co., Dayton, Ohio, tools and fixtures, 1892; Pratt & Whitney, mach. guns, rapid fire guns, shoulder arms, 1894–1895; W. H. Honiss, Hartford, Conn., type justifying mch. 1895–1896: Unitype Co., Brooklyn, N. Y., type justifying and setting mchy., 1896–1899. Shop experience: Port Chester Bolt & Nut Co., 1886–1889; Pratt & Whitney Co., assistant foreman, small tool department and tool maker, 1889–1891; Nat. Cash Register Co., tool maker, 1892. Other engineering work: Wm. A. Lorenz, chief draftsman and designer, 1899–1907; on automatic paper bag machinery, food preparing machinery, rubber working machinery and inventing new machinery and processes for lessening the cost of manufactures; original designs constructed under personal supervision. Present position, Mechanical and consulting engineer.

References: H. W. Cheney, Robt. J. Simpson, Wm. A. Lorenz, Wm. H. Honiss, Chas. W. Sponsel.

HENRY DIXON MILES, Buffalo Foundry Co., Buffalo, N. Y. Born, Miles Grove, Erie Co., Pa., October 1864. Education: Pennsylvania State College, B.S. 1889. Apprentice: Union Switch & Signal Co., Pittsburg, Pa., on signal appliances, 1889–1890. Drafting room: Union Switch & Signal Co., Michigan Central as signal engineer until 1892. Shop experience: Union Switch & Signal Co., in mechanical, electrical and electro-peneumatic signal appliances 1889 and 1890. Other engineering work: Constructing engineer for Union Switch & Signal Co., after leaving shop, until 1892. Signal engineer Michigan Central R. R., 1891

until 1902. Asst. superintendent of the M. C. R. R. until 1903. Designed and patented signal appliances. Engineer on a power plant installation in the M. C. R. R. Present position, President of the Buffalo Foundry Co., since Oct. 1903.

References: Thos. H. Mirkil, Jr., Geo. M. Basford, Louis E. Reber, John P. Jackson, F. Du P. Thomson.

WILLIAM KNOX MILLHOLLAND, Indianapolis, Ind. Born, Baltimore, Md., February 1856. Education: Four years Maryland Institute of Art & Design. Apprentice: Flynn & Emrich, Baltimore, Md., 1873–1877. Drafting room: Designing special machines; Superintendent Falls Rivet & Machine Co., Cugahoga Falls, Ohio, 1881–1886. Designed and built special machine tools; invented rapid production rivet making machines. Other engineering work: Six years tool maker and designer for M. C. Bullock Mfg. Co., Chicago, Ill., 1893; eight years superintendent for the Geo. D. Whitcomb Co., Chicago Ill., mining machinery, designed and built coal cutting machinery, knitting machines; six years salesman for Gisholt Machine Co., Madison, Wis. Present position, Secretary, International Machine Tool Co., Indianapolis, Ind.

References: C. L. Libby, Geo. Langen, G. L. Crook, W. M. Taylor, J. S. Lane.

WILLIAM OTIS MOODY, 902 Central Station, Chicago, Ill. Born, Chicago, Ill., January 1867. Education: Three years Manual Training in Chicago. Apprentice: Machinist trade, I.C.R.R., locomotives, both machine and erecting, 1890–1893. Drafting room: Allis-Chalmers Gates Plant, engines and mining machinery 1894–1896; Fairbanks, Morse & Co., part of 1895, engines and water tanks, Illinois Central R. R. chief draftsman 1896–1905. Shop experience: I. C. R. R., 1890–1893; St. Francis Lumber Co., St Francis, Ark., engineer 1888; Roots Positive Pressure Blower Co. at World's Fair, engineer 1893; I. C. R. R., foreman on steel passenger car construction 1903–1904. Present position, Mechanical engineer Illinois Central R. R.

References: Spencer Otis, C. D. Pettis, Chas. H. Ferry, John Mitchell, W. H. V. Rosing.

SAM L. NAPHTALY, 1770 Pacific Ave., San Francisco, Cal. Born, San Francisco, Cal., November 1874. Education: Four years University of California. Other engineering work: California Light and Power Co., 1896–1897. Central Light and Power Co., installed 1200 kw. plant, 1897–1900. S. F. Gas & Electric Co., installed 10 500 kw. plant and laid out a 5000 kw. turbine addition for same, 1900–1905. Had charge of construction and engineering until latter company was merged into Pacific Gas and Electric Co., 1905; charge up to March 1, 1907, as engineer, of the power houses, plants, transmission and water systems of Pacific Gas and Electric Co., and California Gas and Electric Co. Present position, General manager and engineer, American River Elec. Co., Trucker River Genl. Elect. Co., Reno Light, Power & Water Co., City Elec. Now engaged in erection of 4000 kw. turbine plant for San Francisco and 1500 kw. turbine plant for Stockton, Cal.

References: Robert Forsyth, W. R. Eckart, H. A. Lardner, Fred Sargent, C. R. Weymouth.

WILLIAM AYLMER RANKIN, Painesdale, Michigan. Born, Lisbon, Ohio, September 1858. Education: Cleveland Medical College, M.D. 1879. Drafting

room: Designed and built reservoir and pump house for Lisbon, O., water works 1887; Anaconda Copper Mining Co., designed and built steam power house and rebuilt pole lines, 1896–1897. Other engineering work: Westinghouse testing room work, 1889: Richmond Railway and Electric Co., Richmond, Va., steam fitting and general repairs, 1890; Phoenix Iron Works Co., Meadville, Pa., erecting man, 1891–1893; Westinghouse Electric and Mfg. Co., Pittsburg, Pa., erecting man, 1894–1895; Anaconda Copper Mining Co., Anaconda, Mont., in charge of all electrical construction at Washoe Smelter, Anaconda, 1896–1903; Michigan Smelting Co., Houghton, Mich., superintendent of all construction work in building of Michigan Smelter, 1903–1906; Allis-Chalmers Co., Milwaukee, Wis., 1905–1906. Present position, Chief engineer designing and constructing power plant for mines of Copper Range Cons. Co.

References: C. H. Repath, R. H. Corbett, F. H. Crabtree, A. J. Hill, M. Rotter, J. Lyman.

CHARLES LEONARD REEDER, 919–921 Equitable Bldg., Baltimore, Md. Born, Baltimore, Md., October 1876. Education: Johns Hopkins University, partial course. Apprentice: General Electric Co., Schenectady, 1896–1897. Drafting room: F. H. Hambleton, Baltimore, consulting enginneer, 1897–1898. Shop experience: General Electric Co. Other engineering work: Consulting mechanical and electrical engineer, power plants, buildings and factories, 1898 to present date; Skinner Ship Building and Dry Dock Co., Baltimore, a new dry dock; plans and specifications for power and pumping plant and the erection, 1898–1903; Edison Electric Illuminating Co., Cumberland, Md., partial revision of power plant, entire lighting and railway feeder systems, 1899–1902; American Can Co., Baltimore, plans and supervision of Baltimore factories, 1902–1904; Henderson Lighting and Power Co.; Phoenix Pad Co., Baltimore, factory building and electrical and mechanical equipment of same, 1904–1906; Lord Baltimore Press, central power and lighting plant, subsequently the supervision in full 1905 to present date; similar work for office buildings, asylums, high schools, etc. Present position, Consulting engineer.

References: J. J. de Kinder, A. C. Wood, P. O. Keilholtz, W. D. Young, F. L. Hart.

THOMAS RICHARDSON, 9 Concord St., South Norwalk, Conn. Born, Manchester, England, August 1871. Apprentice: Machinist, Norwalk Iron Works Co., 1887–91; air compressors and steam engines. Drafting room: General Electric Co., Lynn, motors, 1899; Sprague E. E. Co., motors and generators, 1900; Edison Portland Cement Co., general engineering, 1900; Westinghouse Church Kerr & Co., power station design and general engineering, 1901–1905. Shop experience: Six years journeyman machinist, Norwalk Iron Works Co., air and gas compressors. Other engineering work: Draftsman and checker with Westinghouse Church Kerr & Co., on Kingsbridge and Long Island City power stations; contract engineer with Robins Conveying Belt Co., charge of design and construction of coal handling plants for Pawtucket Gas Co., J. R. White & Son, Providence, R. I. and Hudsons Co.'s., Jersey City power station. Present position, Chief draftsman, W. S. Barstow & Co., New York City; power station and industrial plant design and general engineering.

References: W. E. Lape, K. O. Truell, G. B. Caldwell, E. J. Haddock, E. C. Sickles, A. T. Nickerson.

FRANK ROBERT SCHOOLFIELD, 177 Park Place, Brooklyn, N. Y. Born, Audrain Co., Missouri, November 1871. Education: Tufts College, B. E. E. 1898. Apprentice: Baltimore & Ohio R. R. four years as machinist 1887–1891. Drafting room: Baltimore & Ohio R. R., Baltimore, Md. 3½ years draftsman, locomotive and car designs, 1891–1894; Hodges & Harrington, Boston, street railway power houses, 1898–1899. Shop experience: Somerville Elec. Lt. Co., Somerville, Mass. 1897, during vacation. Other engineering work: United Railways & Electric Co., Baltimore, on power and boiler house designs, location of apparatus, layout and installation of piping, foundations and machinery, 1899–1901; chief engineer power house and generating plant, Baltimore Copper Smelting & Refining Co., Canton, Md., 1901–1905; chief draftsman, Brooklyn Rapid Transit System, Brooklyn, N. Y., surface and elevated car construction and equipment, 1905; Ford, Bacon & Davis New York, 1906 to date. Present position, Mechanical draftsman and engineer, Ford, Bacon & Davis, New York.

References: H. S. Isham, W. W. Nichols, P. O. Keilholtz, F. E. Town, T. A. Sanguinetti.

JOHN WILLIAM SCOTT, Warner Sugar Refining Co., Edgewater, N. J. Born, Ireland, April 1863. Education: Londonderry Academy. Shop experience: Superintendent the equipment of machine shop, New York Sugar Refinery, L. I. City, 1897; laid out, erected and equipped machine shop, Warner Sugar Refinery, Edgewater, N. J., 1907. Other engineering work: Connected with the sugar refining industry since 1886. Inspector of Works, 1897–1898; assistant engineer, 1897–1906; New York Sugar Refining Co., also first assistant superintendent, 1900–1906. Supt. Warner Sugar Refining Co., 1906–1907; designed office and shops, and in charge of erection machinery and equipment. Present position, Superintendent, Warner Sugar Refining Co.

References: Robert S. Kent, Louis G. Engel, Carl Von Coeben, J. W. Ferguson, Frank J. Logan.

JULIAN CHATARD SMITH, Dodge & Day, Drexel Bldg., Philadelphia, Pa. Born, Maryland, March 1869. Education: Stevens Institute of Technology, M.E. 1901. Drafting room: Draftsman on cable railway construction work Baltimore City Pass. Ry. Co.; conduit electric railway construction work, Metropolitan St. Ry. of Washington, D. C. Other engineering work: Florida Rock Phosphate Co., assistant superintendent and chemist, June to October 1891; cable and electric railways in Baltimore, Washington and Seattle in the various positions of draftsman, engineer, chief electrician, assistant superintendent, Superintendent of both construction and operation manager, until 1897; for six months, civil engineer, Buxton Water Co., Crisfield, Md.; general contracting in Baltimore, Morton & Smith, 1897; New York, general contracting, Hudson Contracting Co., and Smith & Robinson, 1899 until 1905, river and harbor work; government contract work, as Breakwater at Larchmont, Port Jefferson and Glen Cover, Long Island Sound, N. Y.; dredging and jetty building on route of Inland Waterway between Delaware Bay and Chincoteague Bay, Va., reinforced concrete culvert, Charlestown, Mass., Navy Yard; dock building, sewerage construction and reinforced concrete work; J. G. White & Co., New York, cofferdam and sub-aquatic rock excavation work, until June 1906. Present position, General superintendent of construction, Dodge & Day, Phila., Pa., 1906 to date.

References: H. B. Atkins, Conrad N. Lauer, R. M. Anderson, H. W. York, Henry C. Meyer, Jr.

P. EDWIN VAN SAUN, 2 Rector St., New York, N. Y. Born, Maywood, N. J., June 1877. Education: Stevens Institute of Technology, M. E., 1898. Drafting room: Rogers Locomotive Works, Paterson, R. I., 1898–1899; Colorado Iron Works Co., Denver, Colo., mining and metallurgical machinery, 1899–1902. Shop experience: Supervision of shop work much of time with Colorado Iron Works Co., and in present position. Other engineering work: Responsible for design of all machinery and equipments of Traylor Engineering Co., engineered the design and installation of the following plants; 300 ton Conc. Mill, Green Mt. M. & M. Co.; crushing, roasting and bleaching plant, Vanadium Alloys Co.; 100 Stamp mill, Palmer Mt. Tunnel and Power Co.; 500 ton smelting equipment, Dominion Copper Co.; 250 ton conc. and cyanide plant, Bull Frog R. & W. Co.; 250 ton conc. mill, Giroux Cons. M. Co.; contracting for and equipping complete mining and metallurgical plants. Present position, Chief engineer, Traylor Engineering Co.

References: Earle C. Bacon, Geo. T. Ladd, Theron H. Tracy, H. F. Frevert, John H. Kelman, D. S. Jacobus.

W. N. WALMSLEY, Sao Paulo Light & Power Co., Sao Paulo, Brazil. Born, Terre Haute, Ind., August 1871. Education: Three years Rose Polytechnic Institute, Terre Haute, Ind. Apprentice: Thomson-Houston Co., installation plants, testing and experimental work. Shop experience; Railway testing department, Thomson-Houston Co., Lynn, Mass., on apparatus for World's Fair. Other engineering work: Central station and general electric work, Philadelphia office of Westinghouse, Thomson-Houston, and Walker Companies, 1890–1891; electrician, Red Star Line, 1891–1892; superintendent of overhead construction and charge of maintenance, Electrical Traction Co., Philadelphia; electrical engineer, Fairmount Park Transportation Co., 1896–1897, and Woodside Park, March-August 1897; engineer to contractor, Bucks County Railway, 1897–1898; engineer, Holt, Schober & Co., Philadelphia, on Toledo and Monroe Electrical Railway, 1898–1899; construction, Philadelphia, Morton & Swarthmore Railway; chief engineer and general manager, The MacAfee Co. Present position, General Manager, Sao Paulo Tramway Light and Power Co.

References: By-Law 2; F. S.Pearson, H. P. Quick, Maurice Coster, W. M. McFarland, L. J. Hirt.

WILLIAM A. WARMAN, 570 West Broadway, New York, N. Y. Born, Latrobe, Ohio, June 1861. Shop experience: Developing inventions, 1878–1886; various western shops, 1886–1892; Rodwell Co., Buffalo, 1892–1894; own shop, Niagara Falls, 1895–1896; Buffalo Metal Mfg. Co., 1897. Other engineering work: Ritter Dental Co., superintendent and designer of special tools, 1898–1901; Dick Press Guard Mfg. Co., designing and constructing of machine tools, automatic machinery, power presses, etc., 1902–1903; American Tobacco Co., 1904; Warman Co., 1905, consolidated with the Keller Mech. Engraving Co., manufacturers of die cutting and special automatic machinery. Present position, superintendent and designer, Keller Mech. Engraving Co.

References: F. A. Halsey, R. B. Cochrane, Fred. J. Miller, H. L. Duerner, J. T. Burr.

GEORGE MONROE WISNER, 1500 American Trust Bldg., Chicago, Ill. Born, Detroit, Mich., February 1870. Education: University of Michigan, B.S.

C.E., 1892. Other engineering work: Engineer in digging original channel for sanitary district Chicago, Chicago Drainage Canal, rodman, July 1892, and all positions from that up to present one. For four months acting chief engineer. Charge of river improvement, bridge building, rock and earth excavations, concrete work, docking, power house hydro electric construction, pumping plants, testing of turbines. For last year acting as superintendent of three miles of rock excavation and concrete wall construction. Executive charge of designing for several years. Present position, Assistant chief engineer, Sanitary District of Chicago, having charge of hydraulic electric and mechanical work in connection with the hydro-electric plant, bridges, etc.

References: Edward B. Ellicott, C. E. Sargent, W. L. Abbott, James Lyman, Geo. M. Brill.

SHERMAN MELVILLE WOODWARD, U. S. Dept. of Agriculture, Washington, D. C. Born, Richfield, Minn., May 1871. Education: Washington Univ., M. S., 1893; Harvard, M. A., 1896. Drafting room: St. Louis Water Department, summer vacations of 1891 and 1892; Scullin Electric Railway lines in St. Louis, part of time in drawing room and part of the time engaged in staking out and inspecting track extension work, summer of 1893. Other engineering work: St. Louis Water Department, engaged in researches in testing laboratory, 1896; University of Ariz. teaching subjects in mechanical engineering, 1896–1904; Professor of steam engineering at State University of Iowa, 1904–1905; U. S. Department of Agriculture, since July 1905; several months on tests of internal combustion engines on alcohol as fuel during 1906–1907. Present position, Irrigation engineer, U. S. Department of Agriculture, supervising and carrying out lines of original investigation in the use of power as related to agricultural development.

References: Chas. E. Lucke, Wm. B. Gregory, M. L. Holman, Chas. E. Jones, F. E. Bausch.

FOR PROMOTION TO FULL MEMBERSHIP

CHARLES JAMES BACON, Illinois Steel Co., So. Chicago, Ill. Born, Ravenna, Ohio, May 1877. Education: Mass. Institute of Technology, special course 3½ years. Drafting room: Fore River Shipbuilding Co., general engine drafting, 1901–1902. Shop experience; In marine shops, Lockwood Mfg. Co., and Bertlesen, East Boston, Mass., aggregating about one year. Other engineering work: Fore River Shipbuilding Co., charge of material testing, 1902–1903; Interborough Rapid Transit Co., Manhattan power station, charge of mechanical testing, 1905–1906; Illinois Steel Co., assistant steam expert, general supervision of steam, hydraulic, gas and pneumatic power, 1906–1907. Present position, Steam Engineer, Illinois Steel Co., South Works.

References: Henry G. Stott, Peter A. Newton, H. J. Freyn, J. Easthope, Paul P. Bird, Geo. B. Bartlett.

Elected Junior member, 1905.

EDGAR HENRY BERRY, Wyckoff, Seamans & Benedict, Ilion, N. Y. Born, New York, N. Y., October 1876. Education: Cooper Union, B.S., 1894. Drafting room: W. B. Parsons, New York Rapid Transit Commission, New York, June-Dec. 1891. Electrical equipment department, U. S. Navy Yard, Brooklyn,

N. Y., 1893–1902. C. W. Hunt Co., hoisting machinery, industrial railways etc., West New Brighton, N. Y., 1902–1903. Shop experience: C. W. Hunt Co., West New Brighton, N. Y., on erection and installation of hoisting machinery, Mar.-Dec. 1903. Other engineering work: Three years at the Brooklyn Navy Yard, in charge of the drafting room, designing standard electrical fixtures and appliances used throughout the Navy, and designing the electrical equipment of all vessels fitted out at the Brooklyn yard, and for one year in charge of the erection and installation of electrical hoisting machinery. At present chief engineer with Wyckoff, Seamans & Benedict, superintending the experimental, tool making and manufacturing departments, and the power plant. Responsible for the selection of standard machinery, and for the design and construction of all jigs fixtures and special machine tools; introduced machine molding in the foundry, extended the employment of grinding operations to replace milling and filing. Present position, chief engineer with Wyckoff, Seamans & Benedict.

References: John Calder, D: G. Baker, Edgar H. Mumford, Daniel Ashworth A. L. Goddard.

Elected an Associate 1905.

VIRGINIUS Z. CARACRISTI, American Loco. Co., Richmond, Va. Born, Richmond, Va., August 1876. Education: Bon Air Academy, Va. Drafting room: Richmond Locomotive Works, C. & A. R. R.; Pressed Steel Car Co., 1899–1902. Shop experience: Richmond Machine Works, 1897–1899. Other engineering work: Chief assistant, C. F. Z. Caracristi, mining engineer; chief draftsman and acting mechanical engineer, Intercolonial Railway of Canada; Special inspector motive power department, Baltimore & Ohio Railroad; had charge of shop improvement work, special design of coal dock, round-house and terminal lay-outs, under general superintendent Motive Power on the B. & O. R. R.; mechanical engineer, Fitz-Hugh Luther Co., Chicago, 1904–1905; railway equipment and shops; shop engineer, American Loco. Co., Jan.-July 1906; member, American Association of Railway Master Mechanics. Present position, Assistant shop engineer, American Loco. Co.; shop lay-out, power plant design, machinery installation, etc.

References: J. E. Sague, H. A. Gillis, Wm. L. Reid, G. M. Basford, F. A. Haughton.

Elected Associate, 1904.

HERMAN GAMPER, Sherwin-Williams Co., 104 Canal St., Cleveland, Ohio. Born, Columbus, Ohio, July 1874. Education: Ohio State University, M E. 1899. Apprentice: John T. Lemon's machine shops, general repair work, Columbus, O., 1890–1893. Drafting room: Ingersoll Sergeant Drill Co., Easton, Pa., 1900–1902. Shop experience: Penn. R. R. shops, special tool room work, June-Sept. 1905; Capital City Machine Co., summers of 1896–1897, 1898; general machine shop, C. & G. Cooper Co., Mt. Vernon, O.; erecting Corliss engines, 1899–1900; Ingersoll Sergeant Drill Co. erecting air compressors, 1900–1901. Other engineering work; Instructor in drafting four years Ohio Soldiers and Sailors Orphans Home, Xenia, O.; also instructor in machine shop and forging; superintendent of engineering department, Ohio Soldiers and Sailors Orphans Home, 1902–1906; designed and supervised the installation of a forced circulation, hot water heating system and remodelled the power plant; consulting engineer for the Wilberforce University, Wilberforce, O.; designed and supervised the installation of light, heat and

power plant; supervised installation of drives and addition to L. O. Mills, Cleveland T. S. W. Co.; designed and supervised installation, Chicago Power Plant and new exhaust heating system for Chicago Plant, Sherwin-Williams Co. Present position, Assistant mechanical engineer, Sherwin-Williams Co., Cleveland, O., testing and looking after all their power plants, laying out and supervising any additions or new work pertaining to the power plants and supervising all large machinery installations, coal and oil tests for all factories.

References: E. A. Hitchcock, Arthur L. Williston, C. W. Weick, F. E. Sanborn, John Herbert Fox.

Elected Junior Member, 1900.

HARRY GARFIELD HARRINGTON, 39 Pacific St., Newark, N. J. Born, Newark, N. J., October 1877. Education: Stevens Institute, M.E., 1900. Other engineering work: The N. J. Zinc Co., designing, in charge of construction, mill buildings, power plants, special machinery, railroad work, etc., at the various works of the company, June 1900 to date, designed and had charge of constructing the alteration to oxide plant at Bethlehem, Pa., costing $60 000, designed and constructed by mix house at Newark, N. J. Present position, Assistant in the engineering department, The New Jersey Zinc Co., designing, and in charge of construction work.

References: Wm. H. Bristol, F. De R. Furman, Chas. O. Gunther, Edward Van Winkle, K. O. Truell.

Elected Junior 1900; Associate 1906.

HENRY S. HAYWARD, Jr., Franklin Railway Supply Co., Franklin, Pa. Born, Elizabeth, N. J., December 1876. Education: Stevens Inst. of Technology, M.E. 1900. Drafting room: Pennsylvania R. R., Jersey City, N. J. Other engineering work: Acted as mechanical engineer for the Franklin Air Compressor Co., 1900–1902, designing the power plant and looking after the construction of same; 1902–1905, as mechanical engineer, in business for self, handling mechanical mill supplies. Present position, Assistant to Vice-president, Franklin Railway Supply Co., manufacturing and promoting special mechanical devices for locomotives.

References: H. S. Hayward, Kenton Chickering, A. Kearney, H. H. Maxfield, Edward R. Gnade.

Elected Junior member 1900.

EBENEZER HILL, JR., Norwalk Iron Works Co., South Norwalk, Conn. Born, Norwalk, Conn., February 1875. Education: Yale, A.B. 1897, Cornell M.E. 1899. Drafting room: Norwalk Iron Works Co. Shop experience: Norwalk Iron Works Co. Other engineering work: Superintendent of Norwalk Iron Works Co., since 1902 having charge of their whole plant; taken patents on trolley cars, lock-cocks, stop valves. Present position, Superintendent and secretary, Norwalk Iron Works Co.

References: Ebenezer Hill, Wm. E. Mathews, F. V. McMullen, A. L. Riker, A. W. Burchard.

Elected Junior 1900.

HENRY OTIS POND, Piping Dept., Westinghouse Church Kerr & Co., 10 Bridge St., New York. Born, Tenafly, N. J., February 1876. Education:

Cornell University, M. E. 1896. Drafting room: One year with W. G. Clark, C.E., New York field work and superintendent on test borings for foundations; Kny Scheerer Co.. draftsman and superintendent of shop, six months; American Electrical and Maintenance Co., New York, inspector, chief inspector, nine months. Other engineering work: Since 1904 with Westinghouse Church Kerr & Co., engineer and superintendent of high pressure piping work; charge of design and installation of piping equipment L. I. City Power House, P. N. Y. & L. I. R. R.; design of the service heating and piping, Manhattan Terminal of the P. N. Y. & L. I. R. R.; design and construction of piping, Detroit Edison Co.'s power house; additions to the Peninsula Plant, American Car and Foundry Co.; the design and installation of service equipment, Readville shops of the N. Y. N. H. & H. R. R. including lighting, power, piping etc.; design and construction of additions to plant of General Railway Signal Co., Rochester, N. Y.; addition to the Detroit Edison Co.'s plant 16 000 kw, design and construction of the buildings with their equipment; addition to the power equipment of L. & W. V. R. R., 2000 kw., Scranton; design and installation of the service equipment, hydraulic, steam and pneumatic supply, Benj. Atha Co.'s new plant. Present position: Engineer and superintendent of piping, Westinghouse Church Kerr & Co.

References: Walter C. Kerr, Morris F. Benton, Geo. B. Caldwell, G. B. Preston, H. R. Kent, W. S. Austin.

Elected Associate 1904.

NATHANIEL SUTHERLAND REEDER, Jr., Canada Car Co., Ltd., Montreal, Can. Born, Newport, Kentucky, May 1875. Education: Cornell University, M.E. 1896. Apprentice: P. C. C. & St. L. Ry., Dennison, Ohio, April 1898, locomotives and cars. Drafting room: Blake & Knowles Pump Co., Cincinnati, 1896–1898. P.C.C. & St. L. Ry. Co., Dennison, Ohio, 1898–1900. Shop experience: P. C. C. & St. L. Ry. Co. Other engineering work: Superintendent in charge of Shops and Railroad, Pittsburg Coal Co.; building shops, Pittsburg Coal Co., Coraopolis, Pa.; assistant general manager in general charge of construction and design shops, Canada Car Co., Ltd., Montreal, Canada. Present position, General manager Canada Car Co., Ltd.

References: H. H. Vaughan, Geo. L. Bourne, W. W. Ricker, Geo. W. West, C. A. Lindstrom.

Elected an Associate Member 1902.

CHARLES E. WADDELL, Biltmore, North Carolina. Born, Hillsboro, N. C., May 1877. Education: Bingham Military School. Shop experience: Public Works Co., Bangor, Me., 1895–1896; Asheville St. Ry., N. C., 1896–1897. Other engineering work: City electrician for Asheville; Supt. Light Dept., Public Works Co., summer, 1895; General Electric Co., Boston, under James H. Cutler; built and superintended the Asheville and Biltmore St. Ry., 1892; electrical engineer for the Biltmore estate of C. W. Vanderbilt, 1900; elec. engr. to the Weaver Power Co., of Asheville and built a 3000 h.p. hydro-electric plant together with transmission lines and substations; designed and superintended installation of Asheville Milling Co.'s plant, 150 h.p.; Asheville Cotton Mills, 800 h.p.; Elk Mountain Cotton Mills, 400 h. p.; Asheville and Craggy Mountain Ry., 5 miles of railroad and a 300 kw., 11 000 volt substation, also steam plant and lighting system for town of Mooresville; report and preliminary surveys, 10 000 h.p. hydro-electric plant on Linville river; consulting engineer to City of Rock Hill, S. C.;

designed and installed largest low potential mercury vapor apparatus yet attempted in Biltmore house; designed and installed 150 kw. electric heating plant, Biltmore house; consulting engineer and designer Marion Light and Power Co.'s plants now in course of construction, to aggregate some 3000 h.p.; consulting engineer for Brevard Light & Power Co., hydro-electric plant, 400 h.p.; consulting engineer to City of Statesville; report on Cape Fear Power Co., some 5000 h.p.; engineer in charge of all field work, railroad re-location, etc., for J. S. Bailey Co., in suit between that concern and Southern Ry.; consulting engineer for Tryon Electric Light, Water & Power Co., 2000 h.p., now in process of organization. At present engaged in designing special form of steel tower, long span, experimental construction for Weaver Power Co. Present position, Consulting engineer for Geo. W. Vanderbilt and the Weaver Power Co., Asheville, N. C.

References: Wm. H. Wiley, Calvin W. Rice, C. C. Egbert, Frank S. Tucker, John W. Lieb, Jr.

Elected Associate, 1903.

WILLIAM REUBEN WEBSTER, 208 Brooklawn Ave., Bridgeport, Conn. Born, Oyster Bay, N. Y., April 1868. Education: Cornell University, M.E. 1890. Other engineering work: Westinghouse Church, Kerr & Co., engineer, 1890–1892; Aluminum Brass and Bronze Co., Bridgeport, Conn., engineer, 1892–1893; Bridgeport Copper Co., superintendent 1893–1897; Bridgeport Brass Co., foreman of rolling mill, 1897–1899; Bridgeport Brass Co., superintendent of raw materials department and superintendent of plant, 1899–1902; general superintendent, 1902–1907. Present position: General superintendent, Bridgeport Brass Co., general charge and direction of works.

References: Hosea Webster, John McGeorge, A. W. Smith, H. R. Kent, A. J. Caldwell.

Elected a Junior Member 1893.

GEORGE WHITNEY WILLIAMS, 1008 East 59th St., Chicago, Ill. Born, Mason, Michigan, April 1877. Education: Michigan Agricultural College, B.S., 1896. Drafting room: Webster Mfg. Co., Chicago, Ill., conveying and transmission, machinery and gas engines, 1899–1900, and March to May 1901; C. A. Stickney Co., St. Paul, Minn., gas engines, Aug. 1900–March 1901. Other engineering work: Geo. M Brill, consulting engineer, from May 1901. General engineering of power and manufacturing plants, including the design and arrangement of buildings and equipment, specifications and superintendence; the appraisal of properties; since 1902 acting as chief assistant in charge of all branches of the work. Present position, Assistant engineer, Geo. M. Brill, general engineering.

References: Geo. M. Brill, James Lyman, Charles L. Weil, D. T. Randall, J. M. Sweeney.

Elected Associate Member 1904.

TO BE VOTED FOR AS ASSOCIATES

FRED PERCY BARKER, 288 West Avenue, Buffalo, N. Y. Born, Lewiston, Maine, June 1874. Education: Three years Tufts College, 1898. Apprentice: Metropolitan Park Commission, Boston, 1897–1899; surveying, bridge drafting, transit surveying, boulevard construction, charge of dredging, map drafting, charge of survey party, inspector of construction. Drafting room: Chief draftsman with the Waltham Mfg. Co., Waltham, Mass., Jan. to Dec. 1900, on automobile gasoline engines and motor cycles, assistant chief draftsman, The Lozier Motor Co., Plattsburg, N. Y., 1900–1902 on marine gasoline engines; chief draftsman Waltham Mfg. Co., 1902–1905, on automobile gasoline engines; designer and draftsman, Knox Automobile Co., Springfield, 1905–1906, on automobile gasoline engines. Other engineering work: Conducted automobile class during winter of 1904–1905 for Worcester & Boston Y. M. C. A. Had charge of the design of gasoline engines. Present position, Assistant chief draftsman, E. R. Thomas Motor Co., Buffalo, N. Y.

References: Charles N. Allen, Lucian C. Jackson, Wm. V. Lowe, R. L. Morgan, Thos. K. Morford.

HENRY ASHLEY BOGARDUS, 224 Washington St., Chicago, Ill. Born, Geneva, Ill., February 1881. Education: One year University of Chicago, Chicago, Ill. Apprentice: James P. Marsh & Co., Chicago, Ill., steam gages and steam valves, 1901. Drafting room: James P. Marsh & Co., active charge of designing. Shop experience: James P. Marsh & Co., charge of construction. Other engineering work: James P. Marsh & Co., in design and manufacture of steam gages, steam valves and other similar steam specialties. Present position, Manager, James P. Marsh & Co.

References: Charles W. Elms, Geo. L. Lavery, P. W. Gates, A. J. Hewlings, John M. Ewen.

WALTER CASTANEDO, Glenny & Castanedo, Empire Bldg., Atlanta, Ga. Born, New Orleans, August 1875. Education: Three years special engineering work Tulane University, New Orleans. Shop experience: Southern Electric Co., New Orleans, on repairs and construction of electrical apparatus and isolated plants, 1893–1894. Other engineering work: Four years drafting and engineering in contracting dept., Stilwell-Bierce & Smith Vaile Co., New Orleans; charge of remodelling, designing cotton seed oil mills and pumping plants. Last nine years member of the firm Glenny & Castanedo, sales managers of the Harrisburg Foundry and Machine Works, Harrison Safety Boiler Works, Walsh & Weidner Boiler Co., with offices at New Orleans and Atlanta; designing, remodelling, constructing and contracting for power plants. Present position, Manager, Atlanta office, Harrisburg Foundry & Machine Wks.; sales, erection and testing of engines and general power plant construction and improvement.

References: W. B. Gregory, E. A. Sammons, J. J. Brown, Guy Hopkins, B. T. Allen, A. M. Lockett, H. J. Malochee.

WILLIAM FOSDICK CHAMBERLIN, 448 E. Huffman Ave., Dayton, Ohio. Born, Randolph, N. Y., February 1870. Education: Denison University, B. S., 1893. Other engineering work; Superintendent, The Dayton Table Slide Co., having general charge of woodworking tools and designing from 1894–1904. Vice-

President, The Boyer-Radford Mfg. Co., railroad jacks and railroad specialties, 1901–1906. Gen. Mgr., The Dayton Hydraulic Machinery Co., 1903–1907, having full charge of all departments. Present position, General Manager, Dayton Hydraulic Machinery Co.

References: Alfred A. Thresher, Edward A. Deeds, R. L. Gifford, C. V. Kerr, Wm. T. Magruder.

EDWARD CHAPIN COLLINS, 131 Winthrop St., Taunton, Mass. Born, Westerly, R. I., August 1864. Apprentice: C. B. Cottrell Sons Co., Westerly, R. I., 1882–1885, machinist, erector and inspector. Shop experience: McCoombs & Taylor, Atlanta, Ga., journeyman, one year; Nicholson & Waterman, Providence, R. I., journeyman, one year; A. B. See Mfg. Co., Brooklyn, N. Y., foreman, one year. Other engineering work: Taunton Locomotive Mfg. Co., Taunton, Mass., general foreman, fourteen years; Campbell Printing Press & Mfg. Co, Taunton, Mass., one year as general foreman, two years as general superintendent. Present position, General superintendent, Campbell Printing Press & Mfg Company, Taunton, Mass.

References: William R. Billings, F. W. Dean, N. O. Lindstrom, Ephraim Smith, E. S. Godfrey.

T. V. D'ORNELLAS, Sta. Teresa 91, Lima, Peru. Born, Paris, France, December 1877. Education: Lycée Yanson de Sailly, Pari s, France; three years. École Central des Arts et Manufactures, Paris, France; diploma Mech. and elec. eng'r, 1899. Shop experience: Practical shop working, Union Elektricitats Gesellschaft, Berlin, Germany, 1899–1900. Other engineering work: Engineer of the Light & Power Transmission department, Union Elektricitats Gesellschaft, Berlin, 1900–1901; chief engineer, Studies and Projects department of Cia Iberica de Electricidad Thomson-Houston, Madrid, Spain, 1901–1904. Present position, Electrical consulting engineer of Peruvian Government; professor and chief of laboratory of Industrial Electricity at Engineer School of Lima, Peru.

References: A. L. Kenyon, L. G. Marquina, Pedro Martinto, T. Stebbins.

By-Law 2.

KINGSLEY G. DUNN, 153 Second St., San Francisco, Cal. Born, Georgia City, Mo., January 1871. Early experience: Various power houses and construction work. Other engineering work: Contracting, principally electrical, 1894–1898; superintendent construction B. C. Electric Ry. Co., Victoria, B. C., 1898–1900; general superintendent and chief engineer B. C. Electric Ry. Co., Vancouver, B. C., 1900–1901; Engineer-salesman Chas. C. Moore & Co., Seattle, Wash., 1902–1903; independent engineering work, 1904; engineer-salesman Abner Doble Co., San Francisco, Cal., 1905. Present position, Vice-president Hunt, Mirk & Co., Inc., San Francisco, Cal., design and construction of power plants.

References: A. M. Hunt Jr., Geo. J. Foran, Wm. Schwanhausser, E. C. Sickles, W. A. Doble.

HUGO FUCHS, N. Y. C. & H. R. R. R. Co., Electrical Dept., 335 Madison Ave., New York, N. Y. Born, Kassa Hungary, Europe, August 1879. Education: Francis Joseph University, Budapest, M. E. 1900. Apprentice: Diosgyor, Hun-

gary, Government Steelwork, June-October 1899. Drafting room: Chief draftsman, H. Krantz Mfg. Co., Brooklyn, Oct. 1902–March 1903; switchboard department, General Electric Co., Schenectady, March-June 1903; Chicago Edison Co., Chicago, June 1903–April 1904. Shop experience: Government steel work, Diosgyor, Hungary, June-October 1899. Other engineering work: Assistant electrical engineer in charge of power station construction, Electric City Ry., Budapest, Hungary, June-Oct. 1900; assistant electrical engineer, charge of design of new lines and equipment, Electric City Railway, Budapest, 1901–1902; N. Y. C. & H. R. R. R., electrical department, chief draftsman in connection with electric design of power stations, and in charge of telephone installation, 1904–1906; charge of Research Corps of electrical department handling mainly investigation work in connection with new electrification problems, since October 1906. Present position, Assistant engineer, charge of research corps, electrical department, N. Y. C. & H. R. R. R.

References: E. B. Katte, C. Schwartz, W. G. Carlton, B. V. Swenson, C. W. E. Clarke.

CLIFFORD WAYNE HUMPHREY, 618 Rookery Bldg., Chicago, Ill. Born, Waterloo, Wis., March 1878. Education: University of Wisconsin, B.S.E.E. 1900. Shop experience: Western Elec. Co., Chicago, 1900, one year, dynamo testing three months shop office; Madison Gas and Electric Co., operating engineer, laying out distribution systems, station testing, installing engines, dynamos and general station apparatus, 1901, eight months. Other engineering work: Engineer, Denver Gas and Electric Co., Denver, Colo., charge of engineering department designing and supervising construction work on electric light stations, and distribution systems; designed and built a 2000 h.p. natural draft cooling tower, 2500 h.p. jet condenser, 1200 h.p. of recuperators, station extension of 3100 kw. capacity, 20 miles of transmission lines, 1902–1906; manager and consulting engineer, Northern Colo. Pwr. Co., Denver, Colo., in charge of designing operating and management of electric lighting properties, 18 months. Present position, Consulting and designing engineer, since July 15, 1907; drawing plans, specifications and supervising construction of electric light, power and railway plants.

References: Paul Doty, T. B. Stearns, H. M. Montgomery, L. Searing, H. I. Lee, W. A. Baehr.

FRANK BARNES KLOCK, 206 Lowell Ave., Syracuse, N. Y. Born, Syracuse N. Y., March 1876. Education: Cornell, M.E. 1899. Drafting room: Solvay Process Co., Syracuse, Jan. 1900–1902; Penna. Eng. Works, New Castle, Pa. 1902–1903; Carnegie Steel Works, New Castle, Pa., 1903–1904; Solvay Process Co., Syracuse, 1904–1905; Semet-Solvay Co., 1905–1907. Shop experience: Testing department of Solvav Process Co., February 1907. Present position, Testing department, Solvay Process Co., Syracuse, N. Y.

References: B. N. Bump, A. R. McFarland, Charles L. Griffin, W. E. Hopton, L. A. Zöhe.

GEORGE BENTON LELAND, 196 Atlantic St., Stamford, Conn. Born, Johnson, Vermont, December 1870. Apprentice: E. E. Holmes, Johnson, Vermont, general repair shop and steam engineering, 1889–1891. Other engineering work: Designing, installing and operating in the engineering departments

of Industrial School for Girls, 1891, Middletown Electric Light Co., 1892-1899; designed and installed a complete lighting plant, Aetna Bolt and Nut Co., Southington, Ct., 1899; rebuilt Southington Electric Light Station; later, to 1901, Queensborough Electric Light and Power Co., engineer and electrician; superintendent Norwich Gas and Electric Co., charge of the engineering and operating departments, designed and superintended the installation of a complete plant for the Bulletin Publishing Co., Norwich, Conn., 1901-1904. Present position: General superintendent of the Stamford Gas and Electric Co., engineering, reconstruction and operation; gas and electrical design.

References: F. Ruel Baldwin, Geo. O. Baker, F. A. Waldron, John Turner, S. F. Hayward.

CHARLES WILLIAM LUMMIS, 520 North 2d St., Camden, N. J. Born, Cedarville, New Jersey, August 1880. Drafting room: Drawing office, Camden Iron Works, Camden, N. J., 1898-1899; American Construction Co., Detroit, Mich., erecting machinery, 1899-1901; Wellman-Seaver-Morgan Co., Cleveland Ohio, drawing office and inspection work, 1901-1903. Other engineering work: Camden Iron Works, charge of the design and operation of gas producer plants, and the application of producer gas for power and heating purposes, since 1903. Present position, Mechanical engineer, Camden Iron Works, Camden, N. J.

References: E. Graves, F. V. Matton, E. A. W. Jeffries, Wm. A. Stevenson, D. L. Sumney.

FRANCIS HALSEY NILES, 348 N. Halsted St., Chicago, Ill. Born, Kinsley, Kansas, February 1879. Drafting room: One year on sewer plans, etc., City of Topeka. Shop experience: Designing and erection, ice making and dredge plants, past six years. Other engineering work: In charge of estimating, mechanical specifications, all sales, contracting and outside erection, Featherstone Foundry & Machine Co., Chicago. Present position, Sales agent, Featherstone Foundry & Machine Co., Chicago in charge of engineering and drafting department.

References: C. D. Pettis, Spencer Otis, David Lofts, Elmer E. Hanna, H. A. Magoun.

FREDERICK SCHERR, JR., N. Y. C. & H. R. R. Co., Room 1231, 335 Madison Ave., New York, N. Y. Born, Italy, December 1879. Education: Two years Pratt Institute, Brooklyn; The Federal Polytecnicum in Zurich, Switzerland, M. E., 1904. Apprentice: Delevan Machine Works, Brooklyn, fibre and sugar machinery, 1897. Drafting room: N. Y. and N. J. Telephone Co., Brooklyn, four months 1897 and 1898; E. L. Davis consulting engineer, New York, four months 1898; John Simmons Co., New York, 1904-1905; N. Y. C. & H. R. R. R. Co., since November 1905. Shop experience: Escher Wyss & Co. and Oerlikon Machine Wks., Zurich, Switzerland. Other engineering work: N. Y. C. & H. R. R. Co., charge of the mechanical equipment for terminals and power station equipment. Present position, Assistant engineer, N. Y. C. & H. R. R. Co., power station work.

References: E. B. Katte, C. Schwartz, C. W. E. Clarke, W. G. Carlton, J. I. Lyle, H. Gay.

GEORGE THOMAS SIMPSON, 604 Pioneer Press Bldg., St. Paul, Minn. Born, St. Catherines, Ontario, Canada, October 1871. Apprentice: General

superintendent's office, Canadian Pacific Ry., Winnipeg, 1883-1888. Shop experience: Partner, Electrical Construction Co., constructing four small central station plants and manufacturing transformers, Winnipeg 1890-1892; Ball Electrical Co., Toronto, Ontario, in charge of alternating current work, selling and constructing small central station plants, 1892-1893; manufacturing transformers and incandescent lamps, Hamilton, O., 1893-1900; operated small plant supplying light and power, 1896-1899. Other engineering work: November 1901 to date consulting engineer, St. Paul, Minn.; responsible charge of mechanical and electrical equipment work for various concerns, including St. Paul Foundry Co., foundry and structural steel work; Cass Gilbert, Architect, Minn.; State Capitol; C. Gotzian & Co., Gordon & Ferguson; Noyes Bros. & Cutler. Present position, Consulting engineer.

References: Paul Doty, Morgan Brooks, B. S. Harrison, Judson Lattin, Joseph Garbett.

SAMUEL HORATIO SMITH, Victoria, Australia. Born, Kyneton, Victoria, Australia, October 1879. Education: Scotch College of Melbourne, and Workingmen's College. Apprentice: Direct course electrical and mechanical engineering, turning and fitting, metal working, forging, carpentry and building, surveying, mechanics, electricity, engineering, drafting, chemistry, 1900-1901. Drafting room: Melbourne & Bendigo, Bertsch Insulated Wire Co., and Electric Supply Co., 1900-1903. Other engineering work: Bertsch Insulated Wire Co., on the construction and running of their electric light works and tramways, Bendigo and Ballarat, Victoria; assistant to clerk of works, and constructing engineer on Bendigo Electric Light and Tramway Work, 1902-1903; assistant electric tramway engineer, Bendigo Electric Trmaways, 1903-1904; superintendent electric tramways, Bendigo, 1904-1905; equipping engineer and instructor of motor men and electrical assistants, Ballarat Electric Tramways, May-Sept. 1905. Present position, Superintendent electric tramways, in charge of traffic branch, Ballarat, Victoria, Australia.

References: By-Law 2.

EDWIN RASER STOUGHTON, 104 West 42d Street, New York, N. Y. Born, Milton, Pa. Education: Two years University of Pennsylvania. Apprentice: Building gas engines, Matthews Gas Machine Co., Chicago, 1891. Drafting room: Geo. D. Hoffman, Chicago, Ill., heating, lighting and power construction, 1891-1893; Thatcher Furnace Co., 1893-1896; American Radiator Co., New York, 1896-1899; Buffalo; 1899-1904; Washington, D. C., 1904-1907. Other engineering work: Designed and built original heating boilers for Thatcher Furnace Co.: designed and built original portable tubular boiler for War Department U. S. Government and several ventilating devices to be used with radiators. Present position, Preliminary engineering in heating and ventilation American Radiator Company.

References: F. B. Howell, Julian Scholl, Harvey Middleton, J. E. Powell, Chas. Longenecker.

ROBERT LEROY STREETER, 466 Porter Avenue, Buffalo, N. Y. Born, White Haven, Pa., March 1880. Education, Penna. State College, B. S., 1903. Drafting room: Buffalo Forge Co., engineering department, summers of 1902-1903. Shop experience: Lackawanna Steel Co., Buffalo, N. Y., erecting engines,

June-Nov. 1905. Other engineering work: Instructor in steam engineering laboratory, Penna. State College, 1903–1904; Woodruff-Robins Co., Toronto, Ont., designing power plants for factories and erecting same, 1904-1905; transferred from construction department to mechanical department, Lackawanna Steel Co., 1905. Present position, Steam expert, Lackawanna Steel Co., experimenting on coal and coal tar for boiler fuel.

References: E. P. Coleman, John P. Jackson, Louis E. Reber, Chas. L. Griffin, Bertram A. Lenfest.

JOHN M. TATE, Jr., 805 Empire Bldg., Pittsburg, Pa. Born, Allegheny City, Pa. May 1870. Education: Sewickley Academy. Shop experience: Six years with the Westinghouse Electric & Mfg. Co., Pittsburg, as superintendent of foundry and assistant superintendent; one year as assistant to President of Second Ave. Traction Co., Pittsburg; one year as general manager of the United Traction Co., Pittsburg, Pa. Other engineering work: Organized Tate, Jones & Co., President for past ten years; designed and erected locomotive coaling stations for many railways, complete conveying machinery, installations, natural gas plants, oil burning equipments and furnaces; engineering with special reference to furnace and fuel consumption. Present position: President, Tate, Jones & Co.

References: Chester B. Albree, Geo. H. Clapp, J. Weidman Murray, D. F. Crawford, W. C. Coffin.

CHARLES PHILLIP TURNER, 689 E. 138th St., New York, N. Y. Born, Butler, Montgomery Co., Ill., August 1880. Education: University of Illinois B. S. 1904. Apprentice: Illinois Central R. R., June to September, 1902, overhauling of locomotives. Drafting room: Draftsman, American Steel Foundries Co., East St. Louis, Ill., July-Sept. 1903.. Shop experience: General Electric Co., Schenectady, N. Y., testing department, 1904–1905. Other engineering work: Construction department of General Electric Co. since August 1905, on the installation and operation of Curtis Steam Turbines at the waterside stations of the New York Edison Co. and at the Port Morris Station, N. Y. Central R. R. Present position, Construction foreman, General Electric Co.

References: Seaton M. Scott, Wm. G. Ely, J. J. Chisholm, A. R. Dodge, L. P. Breckenridge.

RALSTON T. WILBUR, Woodland, Cal. Born, San Francisco, Cal., January 1873. Education: Two years Stanford University; two years Yale University, Christian Bros. College, B.S. and M.E. Apprentice: Union Iron Works, San Francisco, 1889, bench, floor and machine work. Drafting room: Foundry department about six years, Anaconda Copper Co., Montana 1895–1897; chief draftsman, Oregon Improvement Co., Port Orford, Ore. Shop experience: General machinist foreman, Port Orford Mills; machinist, Anaconda Copper Co.; machinist, Santa Fe R. R., S. P. R. R., C. P. R. R. etc.; machinist and salesman, Mine and Smelter Supply Co., Denver, Col. Other engineering work: Two years dean of engineering department, Christian Bros. College, St. Louis, Mo.; building and installing engines of torpedo boat Porter at Portland, Oregon; built and designed concentrating mill Black Hawk, Colorado, 1902; full charge building of concentrating plant, Tlalpisahua, Mexico; full charge erection of Port Orford Lumber Mills; installed three power plants in Colorado,

two in Montana, one in Japan, one in South America and three in Mexico; in connection with the erection of Port Oiford Lumber Mills, built six miles mountain railroad, five bridges and one 45° sea wharf. Present position: General manager, Cementos Hidalgo, Mexico.

References: By-Law 2, Dexter S. Kimball, H. S. Spackman.

LEWIS LEIGH WILLARD, 922 Prospect Place, Brooklyn, N. Y. Born, New Berlin, New York, February 1880. Education: Three years Providence Technical School, R. I. Drafting room: Providence Steam Engine Co., Providence, R. I., draftsman and shop work, 1897–1899; International Power Co., Providence, R. I., assistant chief draftsman, 1899–1901; Allis-Chalmers Co., Milwaukee, Wis., designer on large vertical engines, 1901–1902; McIntosh-Seymour & Co., Auburn, N. Y., engines, head designer, 1902–1903. Shop experience: Rand Drill Co., Painted Post, N. Y., chief draftsman and engineer, six months, 1903; Westinghouse, Church, Kerr & Co., N. Y., designer on power plants and railroad equipment, 1903–1905; Allis-Chalmers Co., power machinery, engineer in charge air compressor department, 1905, to date. Other engineering work: Designed and tested new combined pressure and speed regulator, adopted as standard for air compressors by Allis-Chalmers Co.; responsible charge of redesigning full line of compressors and acting as engineer in charge of air compressors and vertical engines. Present position, Engineering Dept., New York office, Allis-Chalmers Co.

References: Joseph J. McKee, H. W. Rowley, W. E. Dodds, J. F. M. Patitz, Henry C. Ord.

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MORRIS LANDA ABRAHAMS, 2106 Arch St., Philadelphia, Pa. Born, Austin, Texas, March 1885. Education: Agricultural and Mechanical College of Texas, B. S. in M. E., 1903; Cornell University, M. E., 1906. Drafting room: Deming Co., Salem, Ohio, general drafting room work, original design on deep-well machinery, hydraulic rams, February-September, 1905. Shop experience: Deming Co., lathe and general machine shop work, June-Sept. 1904; Dean Brothers' Steam Pump Works, Indianapolis Ind., testing floor, testing of pumping machinery, assistant to foreman. Other engineering work: Walter S. Timmis, New York, power plant design, printing plant layouts, development of patent elevator safety device, heating and ventilation, etc. Present position, Engineer with Victor Talking Machine Co., Camden, N. J., improvement of manufacturing working conditions, shop layouts and construction.

References: Albert W. Smith, R. C. Carpenter, W. S. Timmis, W. N. Barnard, C. E. Burgoon.

ALPHONSE A. ADLER, 85 Ashland Place, Brooklyn, N. Y. Born, Prussia, Germany, November 1881. Education: Polytechnic Institute, Brooklyn,; Cooper Union, B.Sc., 1905. Apprentice: Claus Electric Co., machinist and electrical trade, dynamos and general machine work and erection of machinery, 1893–1894. Drafting room: Draftsman, Howard Iron Works, Buffalo, N. Y., 1902; Nonpareil Cork Co., New York City 1903; Westinghouse Church Kerr & Co., 1904–1906; Shop experience: N. Y. Post Graduate Hospital, chief electrician

and assistant engineer, complete charge of entire equipment during absence of chief engineer, 1898; partner in F. J. & A. A. Adler, design and construction small pumping plants and general engineering, 1898–1902. Other engineering work: Warner Elevator Co., engineer in a number of their elevator installations. Present position, Chief Draftsman, W. S. Barstow & Co.

References: Willard E. Lape, A. T. Nickerson, F. J. Wood, R. G. Davis, K. O. Truell.

ALFRED RITTSCHER BENCH, University of Illinois, Urbana, Ill. Born, Galena, Ill., February 1885. Education: University of Illinois, B.S., 1906. Drafting room: Galena Iron Works Co., summer, 1905; mining machinery. Other engineering work: Engineering Experiment Station, University of Illinois, fuel tests, summer 1907. Present position, Instructor in mechanical engineering, University of Illinois.

References: L. P. Breckenridge, D. T. Randall, C. M. Garland.

CARL FRANKLYN BRAUN, 1118 Gough St., San Francisco, Cal. Born, Oakland, Cal., July 1884. Education: Leland Stanford University, A.B. 1907. Drafting room: One month with Union Iron Works, San Francisco, Cal. Other engineering work: Five months field office work with Peninsula Railway Co., San Jose, Cal.; five months miscellaneous work under Prof. W. F. Durand, Stanford University. Present position, Power plant work, Standard Electric Works, San Francisco, Cal.

References: William F. Durand, Harris J. Ryan, W. R. Eckart Jr.

WILLARD COPE BRINTON, 232 W. Swissvale Avenue, Edgewood Park, Pa. Born, West Chester, Pa., December 1880. Education: Lawrence Scientific School, S.B. 1907. Apprentice: General shop training as all around machinist, H. Brinton Co., Philadelphia, 1900–1902, machine tools, black-smithing, tool-making, pattern making, assembling, experimental work and designing on automatic knitting machinery. Drafting room: H. Brinton Co., Sept. to Dec. 1902. Work connected with erecting engineer for the American Water Softener Co., Phila., Feb. to Sept. 1903. Other engineering work: Time and Cost Keeping Departments, William Sellers & Co., Feb. 1902–1903. Erecting Engineer, American Water Softener Co., Phila., in responsible charge of the lay-out, design, and erection of water softening plants in N. Y., Pa., Ohio and Ind.; Feb. to Sept. 1903. Substitute purchasing agent for Becker-Brainard Milling Machine Co., Hyde Park, Mass., three months, 1904. In charge of machine tool inventory and installation of improved piece-work systems for B. F. Sturtevant Co., Hyde Park, Mass., three months, 1905. Special investigations and improvements in shop and office systems and methods for Yale & Towne Mfg. Co., Stamford, Conn. three months, 1906. Present position, Westinghouse Elec. & Mfg. Co., E. Pittsburg, Pa., making a series of written reports in regard to various phases of factory methods, organization and systems.

References: Edw. R. Markham, Ira N. Hollis, Walter B. Snow.

IRWIN BUCK, 110 W. 64th St., New York, N. Y. Born, Albany, N. Y., February 1881. Education: Cornell University, M. E., 1904. Drafting room: D. H. Burrell & Co., Little Falls, N. Y., diary machinery, 1906–1907; Henry R. Worthington, Harrison, N. J., 1907. Shop experience: Henry R. Worthington,

Harrison, N. J., erecting and testing turbine pumps, 1904–1905. Present position, Mechanical engineer, U. S. Industrial Alcohol Co., investigating the adaptability, of alcohol as a fuel in the internal combustion engines.
References: Chas. O. Gunther, C. G. de Laval, J. G. Winship.

PHILIP LANCASTER CLARKE, 618 Chapel St., Schenectady, N. Y. Born, Durango, Col., December 1885. Education: One year Cornell University; Purdue University, B.S. in M.E. 1907. Apprentice: General Electric Co., Schenectady, N. Y.; turbine testing, June 1907. Shop experience: Capital Traction Co., Washington, D. C., summers of 1897 to 1902; Pittsburg Ry's Co. Pittsburg, Pa., summers 1903 to 1905 General machine shop work. Present position, Apprentice, General Electric Co., turbine testing.
References: W. F. M. Goss, L. V. Ludy, G. A. Young, J. D. Hoffman.

HAROLD V. O. COES, 214 W. 82 St., New York. Born, Hyde Park, Mass., June 1883. Education: Mass. Institute of Technology, B. S., 1906. Apprentice: Western Electric Co., New York, regular apprentice course, 1906–1907. Drafting room: Engineering department, Phila. Rapid Transit Co., drafting, testing engines and boilers, designing boiler foundations, June-Sept., 1903, June-Sept. 1904, June-Sept. 1905. Shop experience: Assistant to superintendent, Pope Motor Car Co., Indianapolis, Ind., July-Sept. 1907; three years shop training, wood working, forging, foundry, machine tool. Other engineering work; Assistant to resident engineer, power house construction, Phila. Rapid Transit Co., June-Sept., 1903, charge of putting in concrete boiler and engine foundations, tested engines and boilers, plant tests; designed concrete foundations and ash tunnel for 800 h.p. Parker Boiler, P. R. T. Co., June-Sept. 1905; charge of all piping throughout building while in factory engineer's office, Western Electric Co., conducted boiler and engine tests. Present position, Mechanical engineer and draftsman, engineering department, New York Edison Co.
References: Francis Head, G. Lanza, E. F. Miller.

GEORGE WILLIAM COLE, Westinghouse Church Kerr & Co., 10 Bridge St., New York, N. Y. Born, Staten Island, N. Y., December 1882. Education: Stevens Inst. of Technology, M. E., 1907. Present position, Assistant to engineer in charge, Westinghouse Church Kerr & Co.; power house construction.
References: William S. Austin, Franklin De R. Furman, Fred. L. Pryor, Adam Riesenberger.

RAYMOND EARL CRANSTON, 815 Banigan Bldg., Providence, R. I. Born, Providence, R. I., November 1883. Education: One year Brown University; Mass. Inst. Technology S.B., 1906. Drafting room: Plan department, Factory Mutual Fire Insurance Co.'s, Boston, 1906–1907. J. R. Freeman, Providence, R. I., May 1907 to date. Present position, Assistant to Mr. Freeman, investigation of the water powers of the State of New York provided for under the "Fuller Bill."
References: John R. Freeman, Edwin D. Pingree, P. Schwamb, G. Lanza, F. V. French.

WILLIAM BLACK DODDS, Walnut Hills, Cincinnati, O. Born, Cincinnati, Ohio, July 1882. Education: Purdue University, B.S. in M.E. 1907. Shop

experience: One year testing department, Bullock Elec. Co., Six months C. N. O. & T. P. R. R.
References: W. F. M. Goss, M. J. Golden, J. D. Hoffman, L. V. Ludy, G. A. Young.

EMMET DWYER, 692 Jefferson Ave., Detroit, Mich. Born, Detroit, Mich., June 1881. Education: Detroit, Coll., A.B., 1901. Three years Mass. Inst. Tech. Apprentice: Michigan Stove Co., pattern shops, mounting shops and foundry, 1904–1907. Drafting room: Wood pattern shops at Michigan Stove Co. Other engineering work: Assistant in rebuilding the works of Michigan Stove Co., and installation of electric power, and forced circulation hot water heating systems. Present position, Second Assistant superintendent, Michigan Stove Co.
References: Wm. J. Keep, Chas. L. Weil, Mark M. Sibley.

FRANK EDWARD EBERHARDT, 66 Union St., Newark, N. J. Born, Newark, N. J., December 1883. Education: Three years Cornell University, College of Law, LL.B. 1904. Apprentice: Eberhardt Brothers Machine Co., Newark, N. J., milling machines and gear cutting machines and pattern-making 1904–1905. Shop experience: Eberhardt Brothers Machine Co., in charge of milling and gear cutting department, 1905–1906. Other engineering work: Eberhardt Brothers Machine Co., estimating and cost accounting, 1906–1907; assisted in installation of power equipment, designing details of gear cutting machines, 1904, 1906 and 1907. Present position, Treasurer, Eberhardt Brothers Machine Co.; charge of sales, purchases and estimating.
References: F. A. Halsey, Fred E. Rogers, Edward J. Kunze.

ERNEST DANIEL FIEUX, 225 Riverside Drive, New York, N. Y. Born, New York, February 1885. Education: Stevens Inst. of Technology, M. E., 1906. Apprentice: General Electric Co., Schenectady, N. Y.,1906–1907. Shop experience: General Electric Co., 1906–1907; De La Vergne Machine Co., three weeks shop. Other engineering work: Production Dept., Crocker-Wheeler Co., Ampere, N. J. Present position, Engineer, The Engineering Supervision Co.
References: D. S. Jacobus, James E. Denton, W. H. Bristol.

AIMÉ LUCIEN GEORGES FRITZ, 558 Lexington Ave., New York. N. Y. Born, Germany, April 1884. Education: Cooper Union two years. Drafting room: Western Electric Co., 1901–1902, Westinghouse, Church, Kerr & Co., N. Y., 1902–1904; acted as inspector of steel construction, looked after the piping on the Long Island City Power House as well as for Wabash Station in Pittsburg, Pa.; employed constantly while in the drawing-room on power plant design N. Y. Edison Co., 1904–1905; Westinghouse Church, Kerr & Co., 1905–1907; Other engineering work: Stone & Webster Eng. Corp., Boston, April 1907 to present time; charge of the remodelling and addition to the Charlestown Sta. of the Boston Elevated Ry. and full charge of the subordinate draftsmen. Present position, Resident engineer, and Supt. of Construction, Rumford Falls, Me., for Stone & Webster Eng. Corp., remodelling the boiler plant of the Oxford Paper Co., Rumford Falls, Me.
References: A. T. Nickerson, H. R. Kent, W. S. Austin, W. E. Lape.

HOWARD A. GILLAN, 116 West 90th St., New York, N. Y. Born, New York, N. Y., November 1884. Education: Cooper Union, B.S. 1907. Drafting room: Westinghouse, Church, Kerr & Co., New York, 1903–1906; New York Edison Co., 1906–1907. Shop experience: Westinghouse, Church, Kerr & Co., 1901–1903. Present position, Engineering draftsman, designing and detailing mechanical equipment of power house, New York Edison Co.
References: Henry R. Kent, Walter D. Steele, Seaton M. Scott.

LEWIS JOSEPH HEIZMANN, 318 N. 5th St., Reading, Pa. Born, Reading, Pa., April 1882. Education: Cornell, M.E., 1905. Apprentice: Penn. Hardware Co., summers of 1902 and 1903; machines. Shop experience: Cost keeping department, Penn. Hardware Co., 1905–1906. Other engineering work: Drew up plans and superintended the erection of 4 story factory building, installed machinery in same. Got up specifications and installed 300 h.p. gas producer plant. Installed an electro-plating plant, Penn. Hardware Co. Present position, Assistant treasurer and chief engineer, Penn. Hardware Co.
References: Albert W. Smith, Wm. N. Barnard, Julius I. Wile.

FREDERICK WILLIAM HOLLMANN, Maryland Steel Co., Sparrows Point, Md. Born, New York City, July 1883. Education: Columbia University, M. E., 1905. Drafting room: Maryland Steel Co., Sparrows Point, Md., general drafting, Nov. 1905 to May 1906. Shop experience: Maryland Steel Co., superintending erection of oiling systems of new blowing engines, May-Nov. 1906. Other engineering work: Curtis Marine Turbine Co., South Brooklyn, N. Y., experimental turbine station, summer of 1904; designed 3000 gal. oil filter for blowing engines, 1906; Maryland Steel Co., general steam engineering, Nov. 1906 to date. Present position, Steam engineering, Maryland Steel Co.
References: F. R. Hutton, Simon S. Martin, Chas. E. Lucke.

JAMES MARKHAM AMBLER JOHNSTON, Room 203 Bank of Richmond Bldg., Richmond, Va. Born, Virginia, May 1885. Education: Virginia Polytechnic Institute, B. S., 1904, M. E., 1905; Cornell University, M. E., 1906. Drafting room: L. S. Randolph, general consulting work, power plant, central heating plant, steam laundry building, small ice plant, Sweet Briar Institute, summer and winter of 1904. Other engineering work: P. C. Nugent, C. E., Syracuse, N. Y. water works proposition, summer 1902; J. N. Ambler, City Engr., Winston Salem, N. C. summer 1903; Richmond Cedar Works, Richmond, Va., assistant to superintendent, charge of construction work, repairs, etc., charge of putting reinforced concrete roof on four large dry kilns; designed and built retaining wall 30 ft. high; installed 75 kw. Curtis turbo-generator; designed wiring for lighting property in Dismal Swamp and charge of construction; designed pumping plant. Present position, Consulting engineer.
References: L. S. Randolph, H. S. Morrison, W. N. Barnard, A. W. Smith.

HAROLD HOBART KENNEDY, Pope Motor Car Co., Indianapolis, Ind. Born, Marysville, Ohio, November 1880. Education: Manual Training School. Drafting room: Pope Motor Car Co., Indianapolis, 1899–1906. Other engineering work: Draftsman, chief draftsman, designer and engineer, Pope Motor Car Co., for last seven years. Present position, Automobile engineer and designer, Pope Motor Car Co., electric motor car construction.
References: John B. Whittemore, Theodore Weinshank, William G. Wall.

DANIEL MICHAEL LUEHRS, McCreery Engineering Co., Toledo, Ohio. Born, Cleveland, O., February 1880. Education: Two years Case School of Applied Science, B.S., 1904, Mass. Inst. of Technology, 1905–1906. Apprentice: Standard Lighting Co., Cleveland, Ohio, 1896–1900; new and old sheet metal tools also all shop and machine repairs. Drafting room: Cleveland Engineering Co., 1906; McCreery Engineering Co., 1906. Shop experience: Standard Lighting Co., Cleveland, O., 1900. Other engineering work: On boiler work, International Salt Co., Pt. Huron and Ludington, Mich. Present position, Chief Engineer and superintendent McCreery Engineering Co.

References: C. H. Benjamin, Frank E. Kirby, Alfonso H. Carpenter.

FRANK W. MAGIN, Allis-Chalmers Co., Milwaukee, Wis. Born, Chicago, Ill., April 1883. Education: One year Chicago Manual Training School; three years Evanston High School. Shop experience: Two years, Allis-Chalmers Co., Chicago Works. Other engineering work: Crushing and cement making machinery, Allis-Chalmers Co., for about six years. Present position, Allis-Chalmers Co., engineering and selling, crushing and cement machinery.

References: Thos. W. Capen, Wm. E. Dodds, Chas. C. Christensen, Max Rotter.

EDWARD JOSEPH MARTIN, Bantam Anti-Friction Co., Bantam, Conn. Born, Boston, Mass., September 1882. Apprentice: Ball Bearing Co., Boston, 1897–1900. Drafting room: Ball Bearing Co., Boston, 1890–1900; Steamobile Co., Keene, N. H., 1901–1902; Bantam Mfg. Co., Bantam, Conn., 1903, six months. Shop experience Steamobile Co., Keene, N. H., 1900-1901; Searchmont Auto Co., 1902, six months; Vermont Farm Machine Co., Bellows Falls Vt., cream separators, 1902, six months. Other engineering work: Bantam Mfg. Co., tool-maker, draftsman and foreman, 1903–1904; Vermont Farm Machine Co., Bellows Falls, Vt., 1905–1906; Deane Steam Pump Co., Holyoke, Mass., foreman, 1906–1907; Bantam Anti-Friction Co., Bantam, Conn., superintendent, 1904–1905. Present position, Works manager, Bantam Anti-Friction Co.

References: H. L. Aldrich, W. S. Rogers, J. G. Kingsbury, W. L. Cheney, Edw. H. McClintock, F. R. Hutton.

AUGUST MARX, care of G. A. Gray Co., Depot & Gest Sts., Cincinnati, Ohio. Born, Toledo, Ohio, June 1880. Education: Cornell University, M.E., 1903. Present position, Salesman, The G. A. Gray Co., Cincinnati, Ohio.

References: Henry Marx, Ernst Richter, Harry M. Lane, J. B. Stanwood.

ABRAM COX MOTT, Jr., Philadelphia, Pa. Born, Philadelphia, Pa., January 1879. Education: Three years Cornell University. Apprentice: Abram Cox Stove Co., Philadelphia, Pa., 1898–1904. Drafting room: As above with this company only. Shop experience: Abram Cox Stove Co., general superintendent, 1904, elected also general business manager, 1907. Other engineering work: Buildings, additions, betterments, system, pattern storage, above company's plants. Also since 1905 consulting engineer, Buckhorn Portland Cement Co., Manheim, W. Va. Present position, General manager and general superintendent, Abram Cox Stove company, Philadelphia, Pa. Also, consulting engineer, Buckhorn Portland Cement Co., Manheim, W. Va.

References: J. J. De Kinder, John A. La Fore, Jos. L. Gobeille.

ROBERT EVERETT NEWCOMB, 57 Fairfield Ave., Holyoke, Mass. Born, Holyoke, Mass., September 1884. Education: Cornell University, M.E. 1907. Apprentice: Deane Steam Pump Co., Holyoke, Mass.; pattern making, foundry and machine shop, at intervals between 1897 and 1907 on the various parts of steam and power pumping machinery. Drafting room: Deane Steam Pump Co., Holyoke, Mass., 1905 and 1906; steam and power pumping machinery, steam engine and power plant design. Shop experience: Deane Steam Pump Co.; Present position, Mechanical engineer manufacturing department, Deane Steam Pump Co.

References: Chas L. Newcomb, Samuel M. Green, R. C. Carpenter, Albert W. Smith.

WILLIAM NEWELL, 200 Riverside Drive, New York, N. Y. Born, New York, August 1883. Education: Columbia University, A.B., 1905, M. E., 1907. Other engineering work: Engaged during the past summer in running 24 hour acceptance tests on eleven 75 h.p. Hornsby-Akroyd oil engines, at De La Vergne Machine Co's shops, New York.

References: Frederick R. Hutton, Chas. E. Lucke, Fred. A. Goetze.

RALPH R. NICKERSON, Box 811, Indian Orchard, Mass. Born, Lynn, Mass., June 1885. Education: M.E. Cornell University, 1907. Apprentice: Chapman Valve Mfg. Co., June 1907 to date; lathes, drills, and assembling valves. Present position, Engineering apprentice, Chapman Valve Mfg. Co.

References: C. L. Newcomb, R. C. Carpenter, A. W. Smith, W. W. Barnard.

JAMES URQUHART NORRIS, Rockefeller Institute for Medical Research, New York, N. Y. Born, West Hoboken, N. J., October 1882. Education: Stevens School, Hoboken, three years, Pratt Institute and International Correspondence School. Drafting room: William H. Edmondson, New York, automobile design, 1900–1901. Robins Conveying Belt Co., New York, 1901–1902. Other engineering work: Robins Conveying Belt Co., laying out construction drawings and designing conveyor parts, 1901–1902; Assisting and in charge of erection of coal conveyors at following plants; New Amsterdam Gas Co., Ravenswood, L. I., Kingsbridge Power Station, Richmond Light and Power Co. plant, Livingstons, S. I. and Brooklyn Heights Railroad Co; Power House, Third Avenue, Brooklyn 1902–1904; Assistant to superintendent of erection at New York office, keeping erection costs, pay-rolls, 1904–1905; Assistant to the production manager, June to Dec. 1905, resigned to take present position. Present position: Superintendent of the Rockefeller Institute for Medical Research; charge of all business and engineering connected with the Institute.

References: Frederick A. Goetze, C. Kemble Baldwin, Arthur B. Proal.

JAMES GARWOOD O'KEEFFE, 35 Front Street, Newark, N. J. Born, Richmond, Va., September 1884. Education: 2½ years Virginia Polytechnic Inst.; Stevens Institute, M. E., 1907. Drafting room: W. R. Trigg Co., Richmond, Va., 1900–1902; C. J. Roelker, Richmond, Va., June-October 1905. Other engineering work: C. B. Ford Co., Richmond, Va., designing of special tobacco machinery, June-October 1906; C. J. Roelker, consulting engineer, Richmond, Va., design of water turbines and general engineering work. Present position, Cadet engineer, gas department, Public Service Corporation of N. J.

References: J. E. Denton, D. S. Jacobus, L. S. Randolph, F. L. Pryor.

ERNEST LOUIS RUPF, 227 William St., Port Chester, N. Y. Born, Chemnitz, Saxony, May 1880. Education: Mass. Inst. of Tech., S.B.1904. Drafting room: Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y., one year from July 1904. Shop experience: Horn & Co., Lawrence, Mass., paper machinery summer 1900; Stanley Mfg. Co., Lawrence, Mass., shoe machinery, summer 1901; Hamblet Machine Co., Lawrence, Mass., general machinery, summer 1902. Other engineering work: Designed and built an automobile gasoline engine during the summer of 1903 at Lawrence, Mass., tests for thesis at college; during the past year organized and put in running order branch of Russell, Burdsall & Ward Bolt & Nut Co., in which new methods are used in the manufacture of products; systematizing labor and tools throughout the entire plant. Present position, Assistant to the general manager, Russell, Burdsall & Ward Bolt & Nut Co.

References: Edw. F. Miller, Gaetano Lanza, Peter Schwamb, Emile C. Boerner.

WILBUR NASON SAR VANT, 16 Verona Place, Brooklyn, N. Y. Born, Brooklyn, N. Y., December 1884. Education: Cooper Union, B.S., 1907. Apprentice: Navy Yard, Brooklyn, machinist, general machine shop work, 1898–1900. Drafting room: Western Electric Co., statistical and report department, 1902–1903; mechanical draftsman, Jan.-Oct. 1903; Brooklyn Edison Co., mechanical draftsman and designer for superintendent of construction, 1903–1905; designed several switches for special service in manholes, also electric lamp post for street service in Brooklyn. Shop experience: Inspector electrical conduit subways, Brooklyn Edison Co., Jan.-June 1905; Miller Daybill & Co., 1905–1906, construction engineer, charge of heavy work foundation and intricate shoring; did the bulk of estimating; Bell Electric Motor Co., 1901–1902. Other engineering work: Miller Daybill & Co., office and engineering work, Feb.-Nov. 1902. Present position, Mechanical draftsman, N. Y. C. & H. R. R. Co., design of power plants, in the steam department.

References: W. G. Carlton, H. S. Isham, C. Schwartz, J. P. Sparrow, H. S. Wood.

CHESTER ARTHUR SLOCUM, 58 Chelsea Ave., Long Branch, N. J. Born, Long Branch, N. J., October 1882. Education: Cornell University, M.E. 1906. Other engineering work: Engineer in charge of power plant for the Consolidated Gas Co., New Jersey during the summer of 1904; assistant engineer, Consolidated Gas Co., New Jersey at Long Branch in the electric plant, summer of 1906; designed and superintended the construction of power plants, Takanasse Hotel Long Branch, N. J., Raynor and Perkins Envelope Co., New York City and Joseph J. Little Building, New York. Present position, Mechanical engineer, Walter S. Timmis, New York; consulting engineer.

References: Walter S. Timmis, William B. Tuttle, William B. Barnard, Albert W. Smith.

LEO HARTER SNYDER, Joseph Dixon Crucible Co., Jersey City, N. J. Born, Herkimer, N. Y. September 1882. Education: Cornell University, M.E., 1906. Apprentice: West Albany Railroad shops New York Central R. R. June to September 1903, locomotive repairs. Shop experience: Stanley Electric Co., Pittsfield, Mass., summer of 1905. Other engineering work: Joseph Dixon Crucible Co. in the lubricating department, also work with graphite brushes and resistance

rods. Present position, Mechanical engineer with The Joseph Dixon Crucible Co.

References: Prof. A. W. Smith, Prof. R. C. Carpenter, Prof. H. B. Smith, Prof. Wm. N. Barnard.

FRANK CALVIN SPENCER, 7041 Yate Ave., Chicago, Ill. Born, Cambridge, Mass., April 1880. Education: George Washington University, Washington, D. C. Drafting room: Damon Safe and Iron Works Co., Cambridge, Mass., 1898–1900. Other engineering work: With the Draper Co., Hopedale, Mass., laying out new shops, power transmission, etc., 1900–1901; United Shoe Machinery Co., draftsman on special tools, fixtures, jigs, etc., 1901–1903; responsible for all drawings made, checked and signed them and assumed responsibility of chief draftsman in his absence; received appointment from Civil Service Commission as mechanical draftsman, Ordnance Office, War Department, Washington, D. C., 1903; transferred to Springfield Armory 1905 to take charge of drafting room. Present position: Draftsman in charge of Springfield Armory, Springfield, Mass.

References: H. M. Sage, A. E. Johnson, Alex. W. Moseley.

AUSTIN FRANK STILLMAN, Watson Stillman Co., 26 Cortlandt St., New York, N. Y. Born, Brooklyn, N. Y., July 1882. Education: Cornell, M.E. 1907. Present position, with the Watson Stillman Co., New York.

References: A. W. Smith, R. C. Carpenter, R. L. Shipman.

MASON ALBERT STONE, JR., 82 Beaver St., New York, N. Y. Born, New York, December 1877. Education: Yale University, A. B., 1900; Columbia University M. E., 1903. Apprentice: Pennsylvania R. R., Altoona, locomotive and car work, February 1904 to date. Present position, Special apprentice.

References: B. F. Wood, W. O. Dunbar, C. E. Lucke.

JOSEPH STARR STRING, 130 Arlington Ave., East Orange, N. J. Born, East Orange, N. J., December 1879. Education: Stevens Inst. of Technology, M. E., 1903. Apprentice: Electrical work, Crocker-Wheeler Co., dynamos, motors, etc., the winding of field and armature coils, June-Sept. 1900. Drafting room: Consolidated Gas Co., New York, general and detail drawings of works, buildings, apparatus and connections, at various times between 1904 and 1907. Other engineering work: New York Mutual Gas Light Co., assisted in the work of erecting buildings, apparatus and connections, construction work of a large water gas installation for Consolidated Gas Co.; transferred to the Standard Gas Light Co., manufacturing department, later assistant superintendent of works; resigned and again took up the work of the Consolidated Gas Co. in the engineering department, engaged in the design and construction of its various plants. Present position, Consolidated Gas Co., engineering department, design and construction of its various plants.

References: Jas. E. Denton, D. S. Jacobus, W. H. Bristol.

LOUIS ROSSITER VALENTINE, Woodbridge, N. J. Born, Woodbridge, N. J., November 1883. Education: Stevens Institute of Technology, M. E.,

1907. Shop experience: Machine shop, Chrome Steel Works, Chrome, N. J., during summer 1906; plumbing and pipe fitting, Delamar Copper Works, Chrome, N. J., summer of 1902. Other engineering work: Erection of boilers, N. Y. Glucose Co., Edgewater , N. J., Edgar Water Tube Boiler Co., New York, summer of 1905. Present position, Drafting and construction work, Barber Asphalt Paving Co., Maurer, N. J.
References: F. L. Pryor, F. De R. Furman, E. F. Edgar.

HERBERT LOCKRIDGE WATSON, Sales Eng'r. Allis-Chalmers Co., Milwaukee, Wis. Born, Terre Haute, Indiana, August 1883. Education: Rose Polytechnic Institute, B.S. in M.E. 1905. Drafting room: Kalamazoo Foundry & Machine Co., Kalamazoo, Mich. June to Sept. 1903, June and July 1905, machine tool and structural steel design. Shop experience: Twenty months field erection steam engines and steam turbines for Allis-Chalmers Co. Present position, Sales engineer Allis-Chalmers Co.; special engineering work with reference to steam turbine sales.
References: Max Rotter, Max Patitz, Thomas Gray.

MURRAY E. WEISSBLATT, Crocker-Wheeler Co., Ampere, N. J. Born, New York, April 1879. Education: College of City of New York; Stevens Institute of Technology, M.E., 1900. Apprentice: New York Elec. Co.; interior wiring and lighting installation and wiring for the North River; Elec. Light and Power Co., June and July 1899. Drafting room of Crocker-Wheeler Co., Ampere, N. J., dynamo and motor design, six months. Shop experience: Production department, Crocker-Wheeler Co., attending to the larges machines of the company's output, for last six years. Other engineering work: Present time, direct charge large generators, induction motors, transformers, and alternators; responsible for the duration of manufacture in the factory and meeting the required delivery. Present position, assistant to production manager, Crocker-Wheeler Co., Ampere, N. J.
References: Wm. A. Doble, F. De R. Furman, Schuyler S. Wheeler, L. P. Streeter.

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References: Peter Schwamb, Edw. F. Miller, Frank J. Bryant.

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References: E. S. Fickes, J. W. Logan, Reid T. Stewart.

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References: W. F. M. Goss, J. D. Hoffman, L. V. Ludy.

FOUNDRY CUPOLA AND IRON MIXTURES

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THE CUPOLA

Iron for ordinary castings is melted in a cupola, a vertical brick lined cylinder, in which are charged coke and iron in alternate layers, while air is forced in by a blower.

2 The leading kinds of cupolas have the same general proportions which leave little room for improvement; by measuring a large number of cupolas, before any type had become common, and tabulating records of melting, the writer determined that proportions exert almost no influence upon the melting efficiency. The results depend rather upon the skill or care of the melter.

3 A special form of cupola is described in this article; but so far as details of construction are concerned, there are as many opinions as there are designers, and as good results are claimed with other forms.

4 It does not pay to purchase a small cupola. A 72 inch shell may be lined with common red brick next to the shell and with fire brick inside to bring the inside diameter right—say 36 inches for a small business, to be increased as the business grows. Above the charging door the ordinary five inch lining may be used.

THE LINING

5 Every test the writer has made has shown that for ordinary melting of gray iron the cheapest stock brick may be used to good advantage.

To be presented at the New York Meeting (December 1907) of The American Society of Mechanical Engineers, and to form part of Volume 29 of the Transactions.

6 Square bricks should be used wherever possible, and key or arch bricks only when necessary to turn the circle without leaving spaces between. A stock brick, whether square, split, key or arched, will make as good a lining as the special shaped cupola blocks and is much cheaper. If the stock bricks are laid so that their surfaces touch each other and all spaces are filled with a thin grout, the lining will last as long as if made with large blocks.

7 In procuring brick care should be used in the selection of its size. If "square" or "straight" it should be 9 inches long, $4\frac{1}{2}$ inches wide and $2\frac{1}{2}$ inches thick (100 cu. in.). Good brick of these dimensions can be found at low prices. To produce a lower priced brick the size is often reduced to $8\frac{1}{2}$ by $4\frac{1}{4}$ by $2\frac{1}{2}$ inches (90 cu. in).

8 For special melting using steel scrap, or for continuous melting, a more refractory (and expensive) brick may be needed.

9 In building up the lining the bricks should be dipped in a thin hot grout, made of one third fire clay and two thirds sharp sand, and laid tightly against each other, allowing the grout to fill all spaces. At intervals of two or three feet all the way to the top of the charging door rings of angle iron should be riveted to the shell to allow any section of brick to be renewed without disturbing the rest of the lining.

10 The lining above the charging door will last as long as the shell. The lining from the top of the charging door to the point at which the iron melts (herein termed the melting point) is not cut away by heat, although it is worn by the friction of the charges, and even when but five inches thick will often last several years. At the melting point it is often necessary to renew the lining every six months if the cupola is run to its full capacity. The bosh will need renewing about as often. The brick below the twyers becomes friable on account of the contact of fluid iron, but will last twice as long as that at the melting point.

11 The usual lining is made of the same diameter up to the charging door, and as good melting can be done with such a lining as with any other shape. In the vicinity of the melting point, however, the lining gradually burns away, and it is customary to pick the slag from the surfaces and daub on a thick mortar composed of boiled fire clay and sharp sand, patching the holes with pieces of fire brick to bring back the original shape. But it will be found that the daubing is liable to shrink in drying out, and to fall off while the iron is melting. The accumulation of slag just below the melting point tends to build out the lining toward the center of the cupola into a shape that it will retain indefinitely—a sort of overhanging bosh.

12 The construction herein described is to anticipate this natural action in the cupola by actually building the lining, in the first place, in the shape of this overhanging bosh. Make the lining 12 inches thick in the hearth; then form the overhang by making the lining 16 inches thick above the twyers; thence sloping back for the next 2 feet to the thickness of 5 inches opposite the melting point and the rest of the way up.

13 By this construction the blast is carried to the center of the cupola. The hot products of the combustion therefore do not cut away the lining opposite the melting point as they do with a straight lining; and the shell of the cupola opposite the 5 inch lining is no hotter than it would be with a straight lining 9 inches thick. The cupola can hold more iron and the melting is therefore more rapid; moreover as the lining is thicker just below the bosh, less fuel is needed for the bed and the melting ratio is improved.

THE CHARGING DOOR

14 The usual height of the charging door above the bottom plate is 12 feet, but 15 or 17 feet is practicable. The more iron there is in the cupola the better, as it becomes heated by the waste gases before it reaches the melting point, and is thus brought nearer the melting temperature; even at 17 feet, however, the iron has not become hot enough to melt by the time it gets to the melting point.

15 The charging door cannot advisedly be placed any higher, as the first charge would have too far to fall on to the bed of coke. Moreover, at times when the bottom cuts through, or the blast apparatus is closed down, the bottom must be dropped when the cupola is full, and sometimes it is necessary to use a rod to make a hole through the slag that does not fall through when the bottom is dropped, which is inconvenient when the door is more than 17 feet above the bottom plate.

16 There is no need of a tight charging door. A wire screen let down in front of the opening when the last charge is in will keep sparks from blowing out.

THE TWYERS

17 The distance of the twyers from the cupola bottom depends upon whether anthracite coal or coke is used, and upon the kind of castings made. In using coke, where the iron runs out as fast as melted, the distance from the bottom of the twyers to the sand bottom should be about twelve inches. For machinery castings

the distance should be such that the iron can accumulate without running out of the twyers.

18 The shape or number of the twyers is not of great importance, but the usual construction is of cast iron, bolted to the shell, and of a size to admit enough air to burn the coke in the shortest possible time. The admission of air depends on the friction in the blast pipes at the twyer openings and the blast pressure at the twyers, and the size should be calculated for about eight ounces pressure.

19 It is usual to keep the top and bottom twyer walls nearly horizontal. The sides, however, should be flared toward the center of the cupola to compensate for the partial choking of the admission of air by the fuel and chilled slag lying directly in front of the twyers. The overhanging bosh, described above, helps to form a continuous air chamber and prevents clogging, by melted iron and slag, all around the cupola in front of the twyers, thereby insuring a gentle and even admission of the blast that does not injure the lining. By giving a slight inward flare to the openings, the twyer casting can be made with a green-sand core, but they may be made so wide at the inner end that they nearly or quite touch each other. One or more supports are cast near the inner openings to prevent the top of the twyer from sagging. The shape must be such, however, that when melted iron accidentally rises and chills, it can be pushed out without injury to the twyer.

20 A very good way to form a practically continuous twyer is by means of plates or segments one inch thick, and equal in width to the thickness of the lining at the twyer circle. When the lining is built to within an inch of the blast openings in the shell, a circle of the segments is laid on it. Cast iron blocks 3 inches wide and 4½ inches high are placed on this even with the front of the circle and about seven inches apart. Another circle of segments is laid upon these blocks and then the regular brick lining is continued. This construction leaves a three inch continuous space unbroken by partitions, next to the shell, and permits the air to enter at all points with equal force.

THE BOTTOM

21 The bottom is made of sifted sand from the gangway, dampened, tempered and riddled. The sand should be shoveled in through the breast and stamped with the feet, and then rammed as in molding. Make a close joint around the edges, and have the sand at least 2½ inches thick above the cupola bottom at the level of the spout lining,

(not the bottom doors) and with a level and straight edge make it slope up toward the back ½ inch in each foot.

22 If the bottom is too wet, or is rammed too hard, it is liable to lift up and crack and let the melted iron cut through the bottom doors. To prevent this accident, drill the doors with ½ inch holes 4 inches apart, so that the steam and gases from the sand bottom can escape.

THE BREAST AND TAP HOLE

23 To make the breast, hold a board against the inside of the cupola and ram from the front a mixture of one-third part fire clay, and two-thirds burnt molding sand wet with clay-wash and tempered with new sand.

24 Form the tap hole with a smooth stick, 15 inches long and tapering from a diameter of 2 inches as one end to 1 inch at the other, laid in the breast with its small end against the board. When the breast is rammed full, remove the board, shove the stick in two inches and scrape away the breast at the front to an arch until at the tap hole it is only 1 inch thick.

Operation

CHARGING AND RUNNING

25 In a 72 inch cupola use about four bushels of shavings, and spread some over the bottom and pile them up around the sides to the twyers in front of which lay shavings and splinters. Then lay kindlings evenly over the whole bottom and set soft cord wood on end all around the sides, with some short pieces in the center.

26 For the bed charge 1200 pounds of coke, and light the fire at the twyers and at the tap hole two hours before the wind is to be put on. Build a wood fire all along the spout (which has been lined one inch thick with the same mixture as the breast) and light the fire in front of the breast, leaving the twyers and tap hole open until the coke is well ignited. After the wood is all burned out, close the twyer doors and charge on 500 pounds of coke. Bend the ends of a rod, at right angles, in opposite directions, of such length that when the upper end hangs on the charging door sill, the lower end will be two feet above the top of the twyers. Add enough coke to reach up to the lower end of the rod, and spread evenly on this coke one-half of the first charge of pig iron and scrap, and 100 pounds of coke, then add the other half charge of iron. This makes 1800 pounds of coke on the bed, and 4800 pounds of iron consisting of 3200 pounds

of pig iron and 1600 pounds of sprues and scrap (for stove plate). All the rest of the charges consist of 250 pounds of coke and 3000 pounds of iron. (19.50 pounds pig and 10.50 pounds of remelt).

27 Scatter over each charge of coke two shovelfuls of screenings from the gangways, and two of limestone, broken as small as an egg. Continue charging until full to the charging door. If the fire is lighted at 12 m. the charging should begin at 12.30 p.m. and the wind put on at 2 p.m. Stop the tap hole at 2.10, and tap out at 2.15. With 20 charges (31 tons) the wind should be off at 5 p.m. Fuel ratio 9 to 1, and the melting 10 tons per hour. (Cupola 72 inch shell).

THE BLAST

28 Fast melting fuel must be burned rapidly. With free entrance for air and with a positive blower the speed of melting can be increased by increasing the blast up to 18 ounces pressure. No further increase of speed in melting is obtained with 22 ounces pressure and with 26 ounces the melting will be slower, showing that more air is blown than can be used. About 14 ounces is the best pressure for any kind of blower or cupola. When speed is not required, a lower pressure, (perhaps six or eight ounces) may give more economical results.

29 As good results are obtained with one kind of blower as with another. Those who use a positive blower think they get a stronger blast, but it does not pay to change if the blower already in use is large enough.

ADVANTAGES OF HOT IRON

30 Iron should be melted hot, whether it is to be poured hot or dull. Hot iron is fluid, and gases and slag can separate and castings will be even in grain and free from blow holes.

31 It is important to have a hot cupola before the iron begins to melt. Whether the cupola is small or large, the fire should be lighted two hours before the iron is needed, and the fuel should be well lighted all over the center before the iron is charged.

SLAGGING

32 Slag should be drawn off and not allowed to reach the twyers. The slag hole is a 4-inch square hole left in the brick lining opposite the tap hole with its top about 4 inches below the bottom of the twyers. It is lined and its upper end is stopped with daubing clay. Slag should be allowed to accumulate until it is nearly up

to the twyers as it protects the melted iron from the blast and strains out the dirt. Before the slag runs out of the twyers the slag hole is opened just enough to let the slag run as fast as it forms. By arranging a trough, a crust will form, covering the hot stream beneath; and by raising the crust a little with a bar it will set and form a channel which will keep a steady stream of slag flowing with no noise or escape of wind.

SAVING IRON FROM THE BOTTOM

33 A way to save iron dropped from the bottom of the cupola which has been found better than a cinder mill or any separator is as follows: After the wind is off and all melted iron has run out of the cupola, make a circular dam of sand about four feet in diameter in front of the cupola and about four inches high. Lay a tapping bar across the spout and with a piece of 1½ inch shafting 8 feet long ram in the breast and let all of the slag run out on the floor. The iron will settle under the slag. When the slag is all out, drop the bottom, wet it down and draw it out. In the morning, there being no slag, the bottom can be picked over by hand. All iron is thrown to one side, and any piece of sand bottom, or of slag not containing iron, is discarded. All coke large enough to use is saved; and all small coke and iron is shoveled up and taken to the scaffold, to be thrown in, with all skulls and sweepings containing iron, when the last charge has settled some distance down. The small coke holds down the blast, improving the last melting, and drops again with the bottom. The cupola is so hot that this iron is fit for use for almost any casting.

FUEL RATIO

34 For heavy machinery castings and car wheels, with large cupolas, and when the iron need not be as hot as for small castings sometimes 18 pounds of iron are melted with 1 pound of coke, counting in the bed and not deducting iron or coke dropped with the bottom. For ordinary castings it is not economical to run any risk of having dull iron, because the loss of castings would be greater than any saving of coke.

35 For stove castings, for which the iron must be as hot as for any work, a fuel ratio of 9 to 1 can be maintained constantly with a 72-inch cupola, using a coke bed of 1800 pounds and melting 30 tons in 2¾ hours. To obtain such a ratio it is not necessary to break the pig iron, but all scrap should be broken as small as the pig iron, so

as not to leave voids. The coke, pig and scrap must be charged uniformly. It is better to charge one row of pig iron flatwise around the circumference, then another row inside of this, and so on until the center is filled. One ton of pig iron will make about one thickness all over.

36 Stove plate, sprues and scrap weighing half a ton will take more room than the pig iron and 260 pounds of coke will completely cover the iron charge. The charge for stove plate will be 250 pounds of coke, 1950 pounds of pig iron and 1050 pounds of remelt. On the bed the iron charge is 3200 pounds of pig and 1600 pounds of scrap, and the regular charge of 3000 pounds of iron and 260 pounds of coke then continues through the heat.

37 Greater economy can be obtained if the coke is reduced on the last three charges, and sometimes the cupola will be so hot that the last charge can be melted with very little coke. The smaller the coke charge the faster the melting, provided sufficient coke is used to melt the iron hot. For fast melting, care and cleanliness are essential; no dirt or dust from the charging platform must be shoveled into the cupola, as it will prevent the iron from settling evenly.

QUALITY OF THE COKE

38 The quality of the coke is one of the most important things in iron melting, because the iron is in constant contact with the fuel. Coke should contain about 10 per cent of ash so as not to crush by the weight of the iron, or break up by the heat. If it contains too much volatile matter it will melt and clog the cupola, but the percentage of volatile in good and bad coke varies so little that it cannot be determined by analysis.

39 The sulphur should not exceed 0.75 per cent, but very often amounts to 1 per cent and over. It is estimated that with 0.75 per cent of sulphur in the coke 0.03 per cent will enter the casting; and as the sprues and bad castings are remelted each day it is difficult to keep the sulphur in the castings below 0.08 per cent, which is the limit. In machinery scrap and stove-plate scrap sulphur is estimated at 0.08 per cent. Therefore if the coke contains more than 0.75 per cent of sulphur it is very difficult to use scrap enough to give a close grain without exceeding the above limit and thereby causing hard spots and blow holes in the casting.

40 Since the great demand by blast furnaces for beehive oven coke, it has not been as reliable as when the founder could refuse a car load which did not give good results. Retort oven coke can be

made of uniform quality and it is very satisfactory, but does not look as well as beehive coke.

THE FLUX

41 Limestone is the best flux, and in a slight degree lessens sulphur; but its chief use is to make the slag fluid enough to run out of the slag hole, and to keep the cupola clean especially when the bottom is dropped.

42 It is a question whether the special fluxes on the market do as much good as claimed, but they are worth a trial. Fluor-spar is more efficient than limestone, but is more expensive.

Iron Mixtures

CHEMICAL COMPOSITION AND PHYSICAL QUALITIES

43 It is physical quality that the founder requires, and he would not trouble himself about the chemical composition were it not that by varying it he can vary the physical quality to some extent.

44 By decreasing sulphur, or by increasing silicon, the casting will be made softer. By decreasing sulphur, or by increasing silicon, or phosphorus, or both, fluidity is increased, and the iron is grayer and has less shrinkage. By increasing the manganese the sulphur is decreased or rendered less harmful.

45 But the physical quality of the iron charged, the conditions under which the iron is melted and the manipulation of the fluid iron also materially influence the physical quality of the casting, irrespective of the chemical composition.

PIG IRON

46 Close grained and strong pig-iron is likely to make castings having those characteristics. The close grain is generally accompanied by low silicon and sometimes by high sulphur, but it may have been caused by the original smelting conditions, *i.e.*, whether the blast furnace was cold or hot. Close grain in a soft casting generally means that it is strong, but for the closest grain and the greatest strength the casting is generally as hard as can be tooled.

47 Another reason for using close-grained, low-silicon pig-irons, and pig-irons low in phosphorus, is that they set more quickly, thereby preventing internal shrinkage and porosity. Large castings cool slowly; the interior is fluid a long time after the exterior has become solid, and contracts more and more as its temperature lowers, so

that when its center reaches the freezing point there is not enough bulk to fill the space. In solidfying it crystallizes on the crystals already formed, resulting in a very loose grain at the center; and finally, as the last iron becomes solid, a true cavity is left. Thus we have a shrink hole surrounded by a spongy iron. By feeding hot fluid iron to such a center through a channel which is kept open by churning with an iron rod, every part of the casting can be made solid.

48 By using northern irons made from Lake Superior ores the tendency to sponginess is lessened because they set quicker than southern irons. Or if an iron chill can be placed in the mold in a wall very near the spot that would otherwise be spongy it will set the metal quickly and prevent the trouble.

THE SCRAP

49 Castings made from scrap iron of the same general size and grain as is desired in the casting and cast under practically the same conditions may be expected to have a similar grain—or a tendency toward a closer grain which would require to be offset by the addition of a small amount of a more open pig-iron.

50 An unduly coarse grain in the scrap will close up somewhat in remelting, or close-grain pig iron may be used with it. Small, close-grained scrap, remelted for making a large casting which cools slowly, having a relatively higher silicon will have a coarser grain.

51 Scrap is not ordinarily analyzed, though it often constitutes one half the total mixture. Silicon runs 1.50, 2.00 and 2.40 per cent in heavy, medium, and small soft scrap, respectively, and the sulphur is about 0.08 per cent.

52 In selecting scrap for a mixture, throw out all wrought, burnt, malleable and chilled iron, and all steel.

53 Stove-plate scrap is very close grained, with sulphur about 0.08 per cent and silicon about 2.75 per cent. For machine castings it closes the grain and adds strength, but its silicon is not as effective as in pig iron because of its high sulphur and rather low carbon. The loss in weight during melting is excessive.

54 Select machinery scrap the size of the castings to be made, and break it small enough to melt in the cupola as fast as the pig-iron.

QUALITIES OF IRON PRODUCED

55 Following are chemical compositions and physical qualities desirable in irons for various kinds of work, and some mixtures that will give them.

HARD IRON FOR HEAVY WORK

56 Castings for compressor cylinders, valves, high pressure work, etc.

57 Chemical composition: Si. 1.20 to 1.50 per cent; S. under 0.09 per cent. P. 0.35 to 0.60 per cent; Mn. 0.50 to 0.80 per cent.

58 Physical qualities: Transverse strength of a test bar 1 inch square and 12 inches long, 2400 to 2600 pounds; tensile strength of same bar 22 000 to 25 000 pounds; shrinkage in yokes, 0.160 inch; chill in yokes, 0.25 inch.

59 Mixtures: Steel scrap to the amount of 10 to 25 per cent may be added in the cupola. In a foundry running both air furnaces and cupolas, for castings of over 15 tons, one half of iron from each may be mixed in the ladle to give strength. When the amount of steel exceeds 10 per cent a very small quantity of aluminum should be used in the ladle to increase fluidity. It will remove all gases, prevent blow holes, and give a very close grain. A piece of pure aluminum wire $\frac{3}{8}$ inch in diameter, and 1 inch long, for each 100 pounds of iron, is sufficient; do not use so called "casting aluminum." To insure a perfectly sound interior, make large castings as hard as will allow of machining, by keeping the silicon as low as possible. Select close-grained foundry iron low in silicon, or mill iron if the grain of the foundry grades is too coarse. A close grain in pig-iron accompanies a higher sulphur content which is due to a cold furnace. Charcoal pig-iron gives a close grain with low sulphur.

60 Although using scrap closes the grain, use it sparingly for the strongest castings—sometimes not more than 10 per cent, to avoid introducing sulphur. It is safer to use close-grained pig, and steel scrap. For extra strength, use 1 to 10 pounds of ferro-manganese, either in lumps in the cupola or granulated in the ladle.

61 The best way to close the grain and prevent sponginess is to charge 100 pounds of cast-iron borings with each ton of the mixture packed solid in a covered wooden box six inches deep. The box settles down to the melting point before the wood burns, and then the borings melt and mix, without more than 10 per cent loss. Steel borings and chips can be used instead, but aluminum is needed in the ladle. Do not mix cast iron and steel borings in the same box.

62 In calculating mixtures for heavy castings, allow 1.50 per cent silicon and 0.10 per cent sulphur to be contained in the scrap.

MEDIUM IRON FOR GENERAL WORK

63 Castings for low pressure cylinders, gears and pinions, etc.

64 Chemical composition: 1.50 to 2.00 per cent; S. under 0.08 per cent; P. 0.35 to 0.60 per cent; Mn. 0.50 to 0.80 per cent.

65 Physical qualities: Transverse strength of a test bar 1 inch square and 12 inches long, 2200 to 2400 pounds; tensile strength, 20 000 to 23 000 pounds; shrinkage 0.154 inch; chill 0.15 inch.

66 Mixtures: Nos. 1, 2 and 3 foundry iron. Home and foreign scrap up to 50 per cent of the whole is allowable for the best castings; or more with carefully selected scrap. In calculating mixtures, allow 1.75 to 2.00 per cent silicon and 0.10 per cent sulphur in foreign scrap.

SOFT IRON

67 For general car and railway castings, pulleys, small castings, and agricu tural work.

68 Chemical composition: Si. 2.20 to 2.80 per cent (with less the castings are hard, and with more they are too weak.) For large castings, 2.40 per cent is a good average; S. under 0.85; P. under 0.70; Mn. under 0.70.

69 Physical qualities: Transverse strength bar 1 inch square by 12 inches long, 2000 to 2200 pounds; tensile strength 18 000 to 20-000 pounds; texture: To close the grain use as high a percentage of scrap as will give soft castings.

IRON FOR FRICTIONAL WEAR

70 Castings for brake shoes, friction clutches, etc.

71 Chemical composition: Si. 2.00 to 2.50 per cent; S. under 0.15 per cent; P. under 0.70 per cent; Mn. under 0.70 per cent. The addition of speigeleisen increases hardness.

CALCULATING THE COMPOSITION OF AN IRON MIXTURE

72 A variation in silicon will make castings either hard or porous. The grain of the pig and the fracture of scrap are generally reproduced in the casting. The seller of pig-iron will give a close approximation to the chemical composition of his iron. The ordinary founder will not employ a chemist to make exact determinations.

73 Whether the founder uses the approximate or the accurate determination of his irons, he should calculate the chemical composition of his mixture.

APPROXIMATE CALCULATION

74 Make up on paper the desired mixture, using irons in stock and figure from the analysis, or estimate, of each pig-iron, the previously calculated composition of the home scrap, and the estimated composition of the foreign scrap. Multiply the pounds of each iron used by its percentage of silicon to obtain the pounds of silicon, and divide the aggregate weight of silicon in all the irons by the total weight of iron used, thus obtaining the percentage of silicon in the mixture. Deduct 0.20 per cent for loss in melting. The remainder is the silicon in the casting; and if this is too high or too low to produce the desired percentage, vary the irons and figure again; and so on until you secure a mixture that will be satisfactory.

PRECISE CALCULATION

75 To arrive at the composition by one calculation: If you are forced to use certain irons, determine their weights by considerations of economy, or of stock on hand (for example, enough home scrap to prevent accumulation; enough foreign scrap to cheapen the mixture or to close the grain, and the desired pig irons) and compute the total silicon as before. Then adjust the percentage of silicon in the mixture by calculation from two pig irons, one lower and the other higher in silicon than the percentage just computed, as shown in the following example.

76 An actual stove-plate mixture was desired having 3.50 per cent silicon in a charge of 3000 pounds. The chemist's analysis card had accompanied each car of pig iron. In this case no foreign scrap was used.

	Weight in pounds		Per cent Silicon		Pounds Silicon
Home scrap	900	×	3.25	=	29.25
No. 1 foundry	400	×	2.50	=	10.00
No. 2 foundry	350	×	2.18	=	7.63
No. 3 foundry	250	×	1.53	=	3.82
	1900				50.70
	3000	×	3.50	=	105.00
Needed	1100	×	4.94	=	54.30

77 That is, we needed 1100 pounds of an iron having 4.94 per cent silicon to balance the mixture.

78 We had in stock No. 1 soft with 2.95 per cent silicon, and Ashland silvery with 7.00 per cent silicon; which balanced for the 4.94 per cent as follows:

		Differences		Balances	Total Parts
4.94	No. 1 soft	295	− 199	206	405
	Ashland silvery	7.00	+2.06	199	

1100 ÷ 4 05 = 2.72 pounds = 1 part.
206 × 2.72 = 560 pounds of No. 1 soft needed.
199 × 2.72 = 541 pounds of Ashland needed.
Take 550 pounds of each to make even weights.

79 This example will fit almost any foundry condition. The result can be checked by computing the silicon in each iron as follows:

$$
\begin{aligned}
550 \times 2.95 &= 16.225\\
550 \times 7.00 &= 38.50\\
1900 \quad &= 50.70\\
\hline
3000 \times 3.51 &= 105.42
\end{aligned}
$$

80 Allowing loss of silicon 0.20 gives 3.31 per cent silicon in the casting. The actual analysis was 3.34.

81 If, on the other hand, you have plenty of each of the irons in stock and do not care what proportions you use, calculate as follows:

	Differences	Balances	Parts	Total parts
Home scrap 3.25	−0.25	350	350	2259
No. 1 foundry..........2.50	−1.00	350	350	
No. 2 foundry..........2.18	−1.32	350	350	
No. 3 foundry..........1.53	−1.97	350	350	
No. 1 soft..............2.95	−0.55	350	350	
Silvery 7.00	+3.50	25+100+132+197+55	509	

3000 pounds = 2259 parts. 1 part = 1.328 pound.

Iron	Parts	Weight
Home scrap	350	464.8 pounds
No. 1 foundry	350	464.8 pounds
No. 2 foundry	350	464.8 pounds
No. 3 foundry	350	464.8 pounds
No. 1 soft	350	464.8 pounds
Silvery	509	676.0 pounds
Total		3000.0 pounds

82 But you can only weigh differences of fifty pounds, so divide the 3000 into multiples of 50. If you wish to do so, use 650 pounds of home scrap.

Proof

$$
\begin{aligned}
650 \times 3.25 &= 21.125 \\
450 \times 2.50 &= 11.25 \\
450 \times 2.18 &= 9.81 \\
450 \times 1.53 &= 6.88 \\
450 \times 2.95 &= 13.28 \\
650 \times 7.00 &= 45.50 \\
\hline
3000 \times 3.59 &= 107.84
\end{aligned}
$$

Losses in Remelting

LOSS OF IRON

83 The following is the only reliable published data on remelting losses of which the author knows:

84 In a cupola lined to 52 inches one ton each of several different irons were melted at one time with the results given below. No iron was thrown away, and the data are reliable.

	Kind of Iron	Pounds loss per ton	Per cent
A	No. 1 Cherry Valley Pig (Si. 2.70 per cent S. 0.015 per cent)	95	4.75
B	Cleaned new stove plate	159	7.95
C	Cleaned sprues from stove plate	130	6.50
D	New stove plate with sand on	230	11.50
E	New sprues plate with sand on	280	14.00
F	Old stove plate scrap (rusty)	227	11.35

85 By pickling with hydrofluoric acid it was found that 33 pounds of the 95 pounds loss of *A* was sand purchased on the pigs. Milling a ton of *F* just as purchased showed that 50 pounds of the 227 pounds loss was rust.

Taking results from *A* to *F*:

	Loss pounds per ton	Per cent
The calculated loss from a 37 ton heat (72 inch cupola)	116	5.80
The actual loss from a 37 ton heat (72 inch cupola)	88	4.41

In a small cupola with small heats the loss would be relatively greater.

MEMORANDA FROM THE 37-TON HEAT 72 INCH CUPOLA

Shot iron recovered from the gangway	26 pounds per ton melted
Good sand recovered from the gangway	111 pounds per ton melted
Coke recovered from the bottom	57 pounds per ton melted
Slag tapped out	207 pounds per ton melted
Sand on pig from pig bed	30 pounds per ton melted
Limestone used as flux	43 pounds per ton melted

TEST BARS ½ INCH DIAMETER BY 12 FEET LONG

	Strength	Shrinkage
37-ton heat stove plate	380 pounds	0.149 inches
Remelted cleaned stove plate	390 pounds	0.162 inches
Remelted cleaned plate sprues	375 pounds	0.158 inches
Remelted old stove-plate scrap	377 pounds	0.202 inches
Remelted No. 1 Cherry Valley Pig	410 pounds	0.149 inches

86 In large stove foundries the sprues and plate lost in pouring are charged into the cupola with sand on, it being cheaper to melt the sand than to mill it off; hence the large amount of slag. In machine foundries the gates and lost castings being more bulky, the loss in remelting would be less than in a stove foundry.

87 Boiling of the first iron on the cupola bottom and in the green ladles is likely to form a white core and gray surface in the first castings; therefore pour unimportant work with the first 500 pounds.

LOSS OF OTHER CONSTITUENTS

88 By remelting, carbon is very rarely increased, and is generally decreased; more of it is in combined form than before because the cupola is not as hot as the blast furnace, and because the sulphur is increased.

89 Silicon decreases about 0.20 per cent; sulphur increases about 0.03 per cent; phosphorus remains constant; and manganese decreases about 0.15 per cent; when in the casting it is 0.50 per cent.

90 By using percentages of sulphur, phosphorus and manganese as in the proof, we can find the percentages of these elements in the casting. The object of varying the chemical composition is to control the shrinkage, hardness and grain of the casting, and we must test these physical qualities to ascertain the result of the chemical variation.

91 For the mixture first calculated, a test bar ½ inch square by 12 inches long gave a strength of 430 pounds; shrinkage 0.126; chill 0.06, and hardness 23 degrees.

The analysis was: T. C. 3.43, CC. 3.27, Cd.C. 0.16, Si. 3.15, P. 0.958, S. 0.055 per cent.

MECHANICAL ANALYSIS

92 Turning the above the other way, we find that a shrinkage of 0.126 resulted from 3.15 per cent silicon. We also know that a decrease of silicon increases shrinkage and vice versa; therefore, if the shrinkage rises above 0.126, we must increase the silicon by using more of some iron high in silicon to bring it back, and if it drops below 0.126 we can use more scrap or hard irons, thereby decreasing the silicon and cheapening the mixture.

93 This regulating the silicon from the physical end is a mechanical analysis; and it is the only one, since shrinkage is the only physical quality that varies with a variation of silicon. Mechanical analysis is quick and inexpensive. It can be used by any founder and goes directly to the spot without any chance of mistake.

SPECIFICATIONS FOR IRON AND FUEL, AND METHOD OF TESTING FOUNDRY OUTPUT

By R. MOLDENKE, WATCHUNG, N. J.
Member of the Society

Although one often hears of the fine castings produced by the numerous smaller foundries, where specifications and analysis for purchase and sale are disregarded, mention is seldom made of the carloads of castings rejected on account of excessive hardness or internal sponginess. These foundries generally employ standard material, which can be spoiled only through ignorance. In special lines of foundry work, however, and in the large jobbing shops, iron and other supplies are purchased under specification and are subjected to careful inspection.

2 A comparatively simple set of specifications for all foundry supplies—pig-iron, fuel, fluxes and the newer ferro-alloys—will insure ample results. Since cast iron is primarily a steel with varying carbon content, carrying large amounts of impurities and mechanically mixed with graphite, it follows that a wide range of metal for casting purposes may be secured by varying the proportions of the impurities and of the combined and free carbon. Thus, a cast iron with but 0.20 per cent of combined carbon and near 4 per cent of graphite will really be a "twenty" carbon steel, the graphite merely causing the metal to act like cheese under the tool. The addition of steel scrap to the original mixture—thereby reducing the percentage of graphite without materially altering that of the combined carbon—strengthens the metal, which now, however, will not cut so readily under the tool. Proceeding farther, an increase in com-

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bined carbon and a reduction in graphite, secured by reducing the silicon, will produce an "eighty" carbon steel, with so little lubrication for the tool as to be too expensive to machine.

3 In this way by varying the proportions of combined and free carbon, a wide range of metal is obtained, beginning with the soft, weak, easily machined black iron, rich in graphite, running through the gray and mottled grades, and ending in a hard strong white iron susceptible only to being ground.

4 Since the relative proportions of combined and free carbon may in a great measure be controlled through the silicon, it is generally sufficient to specify the maximum allowable percentages of sulphur, phosphorus and manganese. Normally blown irons, from reputable blast furnaces, run so uniform in carbon content as to render specification unnecessary. An "off cast" renders itself quickly apparent through the other impurities, and is sold only under its true designation.

5 For ordinary machinery castings (gray iron) the pig-iron used as part of the charge should contain:

Sulphur, not more than 0.05 per cent
Phosphorus not more than 0.50 per cent
Manganese not more than 0.80 per cent
Silicon, from 1.75 per cent to 2.75 per cent, as specified.

6 For malleable castings (white iron) the pig iron used should contain:

Sulphur, not more than 0.04 per cent
Phosphorus not more than 0.225 per cent
Manganese, not more than 0.60 per cent
Silicon, from 75 per cent to 1.50 per cent as specified.

A variation of 10 per cent, either way, from the above figures may be allowed.

7 Where light castings are desired, as for stoves and art work, the phosphorus is specified at 1.00 per cent and over, and the si icon often as high as 3.25 per cent. Similar specifications may be prepared to cover the rest of the thirteen rather distinct grades of cast iron, with their more than forty variations.

8 To enable foundrymen unacquainted with the metallurgy of cast iron to buy intelligently, the American Society for Testing Materials, through its committee on specifications for foundry iron, prepared schedules designating the composition of the very deceptive but well known, old grade numbers. Thus No. 1, 2, 3 and 4 are to contain 2.75, 2.25, 1.75 and 1.25 per cent of silicon, respectively, fracture appearances being disregarded. Sulphur is specified at less than 0.035, 0.045, 0.055 and 0.065 per cent, respectively, when esti-

mated volumetrically, with an allowance of one hundredth more in case the gravimetric method is employed. A variation of 10 per cent of silicon either way, from the above figures is allowed; and the sulphur may vary 0.02 per cent. A deficiency of over 10 and under 20 per cent does not lead to rejection, but entails a penalty of 4 per cent in price. This is eminently fair, and protects manufacturer and foundryman alike.

9 In sampling, each car is taken as a unit, and from this one pig is selected out of each four tons. In case of dispute, a pig is selected from each two tons, the loser paying for the additional labor caused by the closer sampling. Drillings from these pigs taken so as to fairly represent the fracture surface, are to be well mixed before analysis.

10 It is interesting to note that the liberality of these specifications, appealing as it does to the conservatives, is in direct contrast to the severer requirements of the foundryman who buys by specifications of his own.

11 Ordinary foundry operations require as fuel anthracite, coke and soft coal, while producer gas, natural gas and oil are employed in the special brass furnaces and in the "Open Hearth" for steel and high grade iron. Necessity for specification is confined to bituminous coal and coke, and in the case of the former only the sulphur, and occasionally the ash, demands attention. The increasing use of the air furnace for the manufacture of high grade engine castings is leading to a study of the availability of various soft coals; and the United States Geological Survey, through its advisory board on fuels and structural materials, has gathered much information, so that specifications for coal and coke for melting purposes may be expected soon. In the meantime, it may be stated that no coal containing more than 2 per cent of sulphur should be used in the foundry, and, preferably, the amount of this impurity should be limited to 1 per cent. Similarly, the ash should be limited to 10 per cent.

12 The employment of coke demands closer attention to moisture, to the remaining volatile matter, fixed carbon, sulphur, ash and sometimes phosphorus. Usually, however, the sulphur, ash and fixed carbon are sufficient to give a fair idea of the value of coke, apart from its physical structure, specific gravity, etc. The advent of by-product coke will necessitate closer attention to moisture. Bee-hive coke, when shipped in open cars where it absorbs much moisture, may, through inattention, cause the purchase of from 6 to 10 per cent of water at coke prices.

13 Concerning sulphur, there is much to be ascertained; whether

its sulphates or its volatile compounds get into the iron, and how. Foundry practice, however, has recognized the fact that a very hot running of the cupola results in less sulphur in the iron. In good coke, the amount of sulphur should not exceed 1.2 per cent; but, unfortunately, the percentage often runs as high as 2.00. If the coke has a good structure, an average specific gravity, not over 11 per cent of ash and over 86 per cent of fixed carbon, it does not matter much whether it be of the "72 hour" or "24 hour" variety. Departure from the normal composition of a coke of any particular region should place the foundryman on his guard at once, and sometimes the plentiful use of limestone at the right moment may save many castings.

14 Limestone to be used for fluxing should be as rich as possible in carbonate of lime, for each unit of silica transformed into slag exacts its equivalent of lime and coke. Oyster shells form a most desirable flux, and fluor-spar tends to thin the slag.

15 Use of the modern ferro-alloys will eventually be limited to the richer grades. Even today 80 per cent ferro-manganese is demanded; and, while 50 per cent ferro-silicon is much used, the 75 per cent grade, or better, is specified by the wide awake foundryman. It is wasteful to employ a rich alloy in the cupola; but in the ladle, removed from the further application of heat, the smaller bulk of the richer alloy causes a smaller reduction in the temperature of the molten iron. For the present, specifications are not required for these alloys, which are made from the best material, and should be low in the undesirable elements, sulphur and phosphorus.

16 In selecting scrap iron, each foundryman chooses wornout or broken castings similar in composition to the proposed product, so that the addition of this scrap to the pig-iron mixture does not disturb the calculations.

17 Beyond the exclusion of burnt or very dirty metal, and of sizes so small as to cause waste in melting or too large to enter the charging door, specifications for scrap iron should be limited to a statement of the class of material wanted—machinery, malleable wheels, pipe, etc.

18 Weak castings and castings with pin holes or with pockets under the skin are indicative of the use of burnt metal. Three hundredths of 1 per cent of oxygen in solution in the iron as an oxid or combination of oxids is, in the case of white irons, sufficient to ruin them completely. The excessive "skulling" of ladles, and other troubles, can be traced to this cause. Thus oxygen in cast iron is far more powerful than even sulphur; yet the action of the former is little understood and does not lend itself readily to chemical investigation.

19 In the matter of molding sands, American foundry practice is far behind that of Germany, or of the rest of Europe. Until the price of our sands has advanced considerably, we shall continue to wet down and mix with a shovel, instead of grinding and sifting and tempering by mechanical means, as in foreign practice. Careful preparation of the sand before it goes to the molding floor will insure castings free from surface blemishes. Under present American conditions, attempts to introduce specifications for molding sands are of doubtful value.

20 The absolute necessity, in the case of a successfully operated steel foundry, for the application of specification to all supplies purchased is so well understood that the steel foundry is usually classed with the steel mill, and apart from the foundry. If the acid process is used, or the Bessemer converter, the metal used is a "fancy" pig iron containing practically only iron, carbon, and the proper manganese and silicon. The basic process allows the use of cheaper material.

21 The characteristics of the finished product are determined either by testing each article, or by testing to destruction an occasional sample, or by the use of test bars.

22 If the establishment makes finished specialties in iron, ease in machining is the important requirement, and an estimate of this quality may be gained by placing an occasional cast sample disc in the lathe or drill press, the nature of the tests being dictated by the experience of each shop.

23 Ordinary commercial castings, on the other hand, must be subjected to additional tests: boiler sections, to determine their resistance to pressure; valves, to ascertain whether they are tight or not. Castings produced in very large quantity must be tested to destruction, by sample, which of course, is far beyond the limits of actual service conditions. The remarkable quality of car wheels has resulted from this exacting system of testing.

24 The foundryman however competent is dependent upon the quality of the iron, for the production of serviceable castings. It is necessary therefore, in the many cases to which testing to destruction is inapplicable to make a test of a sample form composed of iron identical with that in the casting. To day in foundry practice the foundryman may employ shop test bars of such size and shape as he chooses. Comparison of the performance of his test bar with that of the purchaser's test bar will enable the experienced foundryman to determine the degree of exactness with which he is meeting the requirements.

25 Finding that such a variety of standards prevailed, the American Foundryman's Association and the American Society for Testing Materials, under separate action, but by individual members of each committee, have adopted a set of specifications which embodies the last word on this complex subject. These specifications depart entirely from established procedure.

26 It has been attempted in these specifications to avoid the introduction of outside influences as far as practicable, and to have the sample represent accurately the iron as it comes from the cupola or the furnace. Hence, the round sample bar is to be of as large size as the limits of commercial testing machines will permit, it is to be poured in a vertical position, to avoid the difference of strength between top and bottom, if poured horizontally; and the mold is to be dried, to ward off the effect of damp sand. The speed of testing is specified, and a regular routine of pouring is to be observed. At the suggestion of Mr. Walter Wood, this bar is called the "arbitration bar," as it is intended for use only in case of dispute between buyer and seller.

27 The new method of testing, as adopted by the American Society for Testing Materials, is being generally used, and is found to be far superior to the old custom of flat, square bars of small cross section, or the long bars so susceptible of dishonest manipulation. The transverse is best suited to the peculiar nature of cast iron; but an optional tensile test is provided for, at the cost of the party demanding it, although in Germany this latter test is excluded altogether. For further details, the reader is referred to the publications of the two societies mentioned heretofore.

28 The ethics of the cast iron industry has been dependent upon the better understanding of its metallurgy. In times past the foundrymen refused orders to which specifications were attached; and he refused even to provide tentative specifications which might enable the buyer to obtain such iron as he desired to purchase. Now this is changed, and the progressive foundryman welcomes inspection of his methods and tests of his product.

29 It is to the lasting credit of the foundry that the first demand for specifications came from the foundrymen themselves, through their Association, and that they coöperated heartily with the engineer by furnishing information, freely and without reserve, A very friendly feeling between buyer and seller has ensued; for no better evidence of good faith can be given than an invitation to visit freely the shops and the laboratory to inspect manufacture and test. This is the rule today not the exception.

DISCUSSION

HIGH SPEED ELEVATORS

By Charles R. Pratt, Published in October Proceedings

Mr. Clyde R. Place We have had the high speed elevator for a number of years, if 600 f.p.m. may be considered the limit of comfortable travel for persons riding in a car operated at that speed, but we have not had the high lift, high speed elevator with engines occupying so convenient a space as the electric traction type, until very recently.

2 From personal observations and study of tests, it appears to the writer that the Traction Elevator has made possible almost an unlimited height of travel at a comfortable speed and a minimum electrical energy consumption, without sacrifice to control or comfort, while the question of safety is yet under discussion.

3 Theoretically, it would appear that Mr. Pratt has obtained a very happy solution of a feature in electric elevator operation and construction, commanding the attention of all interested and concerned in this branch of engineering; practically, however, there exist certain features about the mechanical and electrical operation, as set forth by the author, which the writer would like to know are solved by regular elevator demonstration and operation before accepting the results to be obtained as set forth in the very complete presentation by the author.

4 Briefly, the author has taken the ordinary worm wheel and worm drum electric machine, decreased the size of the original driving motor to act as a controlling motor in place of the brake, and directly connected a large slow speed motor to the drum shaft and made the drum the traction sheave drive, so that some of the features inherent in the drum electric exist in the author's arrangement, while the spring-actuated brake, forming a mechanical feature, has been eliminated entirely. The resulting mechanism is a composite of the traction-electric and drum-gear electric of today. Whether or no this change is for the best in high-speed, high-lift electric-elevator operation is a question for demonstration and practical solution only.

5 There appear to the writer the following features:

a The control of the motors, the proper accelerations and retardations of the motors, and the tested assurance of their mutual and ready operation under the general conditions of elevator service.

b The proper design of the worm wheel and worm to accomplish comfortable operation of the car and to care for the safety of the elevator equipment and persons in case of some unusual occurrence to the motors or connections.

6 In regard to the first feature, two different elements under one car control are introduced: one, a large slow speed motor, quickly accelerated; the other, a small high speed motor slowly accelerated, both motors having different windings.

7 The question arises whether these two motors can be built, without an unusual amount of testing and adjustment, to operate so mutually that neither will momentarily assume the load function of the other. From the proposed design and operation, it can readily be seen that this condition should not be allowed to exist too frequently for good elevator operation.

8 The fact that a limited amount of work can be put into the traction sheave by the controlling motor before it is stopped by the overload does not signify that the driving motor can be allowed to work back through the worm wheel and worm. This being the case, it would seem necessary to arrange the operation of the controlling motor a little in advance of the driving motor in order to insure that the controlling motor takes care of the acceleration and retardation of the car; only this motor is allowed to accomplish these operations, since it manifest that the construction will not permit this of the other motor. Experiment and demonstration, however, may make it possible to adjust the starting, running and stopping of these motors so as to meet these severe requirements in elevator operation.

9 The second feature, that of the worm wheel and worm design for comfortable operation and safety, brings forward this point.

10 It would appear that the angle of the worm should be considered with the speed of car travel and its average load. While, as the author states, certain angles prevent the worm wheel from driving the worm, other angles allow this action and it does not seem advisable to the writer to construct a worm which cannot be driven to a limited extent, by the driving motor or gravity load.

11 It is noted that the author speaks of the car "gradually" coming to a stop. This action depends upon the load in the car, its

speed and the angle of the worm. These conditions being right, the car will come to a stop "gradually," otherwise not.

12 For example, suppose a car with average load is descending 600 f.p.m. and the controlling motor gets out of order or refuses to do its work in operating the worm, and the angle of the worm is too small for the driving motor or car to drive the worm, what would be the result? The car would be brought to such a sudden stop that not only would the persons in the car be injured but quite likely serious damage to the elevator equipment would result. On the other hand, if the angle of the worm was such as to allow it to be driven by the large motor or car, the car would accelerate in its descent and run away, producing unfavorable results, unless the car safeties were called into action. The question therefore arises,—What is the proper angle for the worm, and can this be definitely determined to meet the conditions likely to arise as noted? It seems to the writer that this question of the correct angle for the worm requires considerable thought, study and demonstration. Either a heavy balance wheel on the shaft of the worm to store sufficient energy might be considered in order to continue the rotation of the worm for a short space of time in the case where the worm cannot be driven by the car, or a small friction brake might be placed on this shaft to act in the case where the worm can be easily driven by the car, but the writer merely suggests these alternates.

13 The Electric Traction type of engine readily adapts itself to many advantageous conditions. It can be placed at the bottom or at the top of the elevator shaftway, as well as at intermediate floors, by a simple rearrangement of the idler sheave. The floor space occupied by the engine is small, and with its compact construction makes it specially adapted for high office building work, as the engine can be placed over the shaftway, and permits more rentable area in the building. This feature is brought out clearly in the elevator layout at No. 1 Wall Street, New York.

14 One of the buildings connected with the Grand Central Terminal Improvements is so constructed and situated that this type of engine has been considered for this building. The building has no basement, this space being occupied by tracks, but has a pipe loft for machinery between the third and fourth office floors while the design is arranged so that the building may be increased in height.

15 The writer anticipates a steadily growing field for the Electric Traction Elevator.

COLLEGE AND APPRENTICE TRAINING

BY PROF. JOHN PRICE JACKSON, PUBLISHED IN OCTOBER PROCEEDINGS

DUGALD C. JACKSON The gentleman who prepared the principal paper for this evening obviously has an axe to grind. It is an axe the grinding of which is of the utmost value to the industries. He wants the great manufacturers to coöperate more heartily in the training of the young men who go into their employ and who are expected to become men of importance in the executive and engineering ends of the establishments. This is desirable. Indeed it is necessary for the best life of the industries. It is being done in some establishments, but it ought to be done in many more.

2 I have another axe to grind. It looks quite like the other gentleman's axe. At least the handle looks quite the same. But it is ground to a somewhat different edge. My complaint is that the industrial establishments and the engineering schools are not holding close enough together. Professor J. P. Jackson speaks of exchanging instructors between the instruction forces of an engineering school and of a great manufacturing company. That would be useful, doubtless, but it is only a drop—a touch and go—toward what is really needed. In Germany there have been close relations between the technical schools and the manufacturers, and the professors and manufacturers have coöperated in the most intimate fashion. The difficult problems of the manufacturers have been worked upon and worked out by the professors, and, in many instances, the professors have been the honored advisers of the manufacturers.

3 The situation is quite different in this country, and it seems to me that our condition is to the serious disadvantage of the industries and also of the work of the engineering schools. The question is, How can this situation be improved? The fault has been on both sides. The engineering faculties have been faulty in being commonly made up of inexperienced young men who are idealists. The latter characteristic is important, and in fact is essential, but it needs to be balanced and squared by experience. The right men are difficult to obtain and the engineering schools have failed to hold out any ultimate place of distinction comparable to the responsibilities borne.

4 Then again the engineering schools have worked their men to the limit of their physical endurance on the immediate duties of instruction, and often of very elementary instruction at that. These have been serious faults of the engineering schools, and there also have been faults on the side of the manufacturers. Some of the engineering schools are now rectifying their faults, and the question is—

What should be done to bring the engineering schools and the industrial concerns into more intimate dependence? That such a result would bring important light to the industries, I feel persuaded those of you who have pondered this question will agree. But the question is how to bring the result about. It can be done, I am sure. It only requires the proper kind of coöperation—coöperation which may call for some getting away from constrained ideas on both sides, but a kind of coöperation which can be brought about to the advantage of both parties.

5 I recently had the honor of drawing a resolution which was passed by the Society for the Promotion of Engineering Education, in which this Society and certain other societies of coördinate importance are invited to join with the Society for the Promotion of Engineering Education in studying this and related questions. I hope that this society will accept the invitation extended to it.

6 Now, there are two more questions to which I wish briefly to call your attention. One of these questions relates to the graduate or advanced study of engineering to which the writer of the paper refers. The majority of the young men who go through the engineering school courses have obtained all of the engineering training of the academic kind which they are capable of assimilating. But there is a considerable proportion, which may be as large as a third of the students graduating, who can profit largely by a year or even two years spent in properly supervised graduate study. I say "properly supervised" advisedly, as few engineering schools appear to have learned that graduate study should consist of the broad and deep study of only two or three subjects, and the student should be thrown largely on his own responsibility in the study of these subjects and should not be harassed by getting up the details of numerous minor subjects.

7 It is to be remembered that the better engineering schools are not trade schools, but are truly professional schools. The industrial corporations ought to appreciate men who have had this additional study under proper auspices and should place them on a distinctly higher level than the men who complete the undergraduate course only. This distinction ought to be made because the young men who have had the benefit of the graduate study under proper supervision are originally picked men and their graduate study, if properly arranged, inevitably adds greatly to their self-reliance, initiative and ingenuity. My experience differs from that of the writer of the paper, as I have found that the industrial organizations desire to employ the men who have followed graduate study in the

courses that I have had to do with, and do give them recognition in advance of that given to men who have only completed an undergraduate course. On the other hand, it must be remembered that very few of the engineering schools possess concurrently all of the requisites for successful graduate instruction, namely, a teaching force sufficiently strong in numbers and in experience, and adequate space and laboratory facilities.

8 The last question which I have in mind to refer to relates to the so called Davis bill now pending in Congress, which has as its object the appropriation of money from the National Treasury for establishing manual training high schools and agricultural high schools in each of the several States. It thus purports to fill the place which the funds derived from the Morrill Land Grant Act, referred to in the paper of the evening, might have filled, had they not substantially all gone toward the maintenance of the distinctly scientific instruction and research in agriculture and instruction in engineering. The Morrill Land Grant Act may properly be named the greatest influence that has been produced in purely American educational processes, but it was a fortunate condition—fortunate for the nation—that the processes built up as the basis of that act have been of relatively slow growth and have not out-run the development of educational sentiment and expert educational knowledge in the land.

9 Also, it is notable that the results of the Act are most strongly in evidence in some of the Western States where the colleges enjoying the benefits of the land grant funds have grown up with the State and have been kept close to good educational practices because a proper educational sentiment and expert educational knowledge has developed along with the college growth. It is quite another thing to appropriate seven or eight million dollars per year which are expected to be matched by an equal sum appropriated by the individual States, and require this money to be expended on a particular educational endeavor for which methods have not yet been perfected or an educational sentiment developed.

10 I believe that such an appropriation might be wisely made if it were conditioned upon the expenditure in each State being made under the advisory direction of an expert State educational commission or commissioner. The Davis bill fails to make such a provision but contains the vicious probability of the money being spent under the direction of independent county boards reporting to the United States Secretary of Agriculture. This is a matter which I commend to the attention of the members of the Society when they are in com-

munication with their representatives in Congress. They should insist upon the insertion in the Davis bill of a provision that money appropriated by that bill shall be spent only under the advisory direction of an expert educational commission or commissioners appointed in each State.

Professor Hammerschlag I had no idea I should take part in this discussion, but I feel I owe it to Professor Jackson of State College to give a different point of view on the subject which has been discussed. The function of the technical school or college, as described in the paper, lays too much emphasis on the benefit to the industries and too little on the duty we owe to the individual. Technical education should primarily be devoted to the development and training of the individual; the interests of the industries are incidental and of secondary importance. The industry, by reason of its economic plan, its position and its power, invariably cares for itself. The student cannot be cared for if we try to serve two masters, one the industries and the other the student—they are diametrically opposed by their selfish interests. The industry is going to buy as much as it can for as little as it can, if it is a well-organized, efficient, financial corporation. The student is going to get as much pay as he can as soon as he works and therefore, it seems to me we must begin with a hypothesis whose financial aspects are such that we must face them in discussing the question of industrial apprenticeships.

2 I have had an opportunity during the last two or three years to come in intimate contact with a great many apprenticed students in the Pittsburg district, and I am going to say this, that I believe that the apprenticeship courses are run for the benefit of the industries and not for the benefit of the students that take the courses, and that the rate of pay to these students makes it impossible for them to live the right kind of life after giving sixteen or eighteen years of time to study and preparation. With living conditions where they are now, it is not possible for a man to live for two years on 10 to 15 cents an hour, which is rather less than we pay the average laborer for digging trenches. Service on this basis destroys his loyalty, and if the industry does not get his loyalty, it does not profit by the student whom it has apprenticed.

3 Another phase of the apprenticeship question makes it objectionable to graduates; it is a paternal system—it raises class and caste in the shop. It makes the men and the foremen resentful when they note the relationship between these students and the employer, thereby destroying harmony and good will. It likewise has this very

definite fault; it is narrow as an educator; it teaches the student merely one manufacturer's output, therefore, it is evident to any employer that the experience and knowledge gained commands only a narrow market and if that is his sole recommendation, to a competing manufacturer, the student finds it almost impossible to get employment that is lucrative.

4 This student organization apprenticeship course in the industries seems to me to have this additional defect, it is demoralizing to the student himself—like a man who is being nursed; he has been leaning on his parents all through his life at school and he finds he still needs someone to help carry his burden. It makes it difficult for him to develop his character, and see the result of his educational preparations. What the student needs more than anything else is something to individualize him, and there is nothing going to make a man of him unless it is hard and keen competition. I don't know how men's characters can be developed unless they are compelled to fight their way. It seems to me that what we need particularly in the industries, and what we need particularly in the technical schools, is a better understanding of the essential training and education which a student needs to succeed immediately after graduation in holding his own with less prepared individuals.

5 Professor Dugald Jackson of Massachusetts Institute of Technology and Professor Park of the Lowell Institute, discussed another phase of this question, dealing with a clearer understanding between teaching staff and practicing engineers, so that we may be able to supplement in the school what the industries fail to give—a species of coöperative education. Personally I feel that this movement which has occupied our attention is nothing more or less than a grave criticism of our technical educational system, and it has led the industries to adopt a reversion to the old world type of the apprenticeship. It is crude and medieval, but it is effective. Now, if it is effective, why not profit by some of its good points? I believe, however, the safest place to put this system into practice is not with those of longest school preparation, but with those of only partial preparation, bringing about thereby active coöperation between the manufacturer and the workman. It seems to me what we have to do is to give these men who are ambitious, who have ability and aspirations, a chance to rise; and then for those who have completed a technical course to ask the industries to take them on their face value.

6 If we fail in this, I feel we are spending too much money on our school trained men, and too little of it in training those who must of necessity be trained in the industries.

In response to the other discussion I would like to state that the Carnegie Technical Schools have had a most cordial coöperation and assistance by the industries in Pittsburg, and my remarks were not made with respect to coöperation in that district, but they were made with the hope that those who planned courses of this character would do well to pause and meet this problem with the consideration that it deserves.

Mr. H. F. J. Porter In order to arrive at the solution of any given problem in the shortest possible time it is always desirable to divest it of all the extraneous unnecessary and misleading features which surround it.

2 The problem before the Society is, as I understand it, How shall the industries secure their skilled workmen?—and Prof. J. P. Jackson proposes that the colleges coöperate with the student engineering courses, which he has described as already existing in manufacturing establishments and in which he sees great promise.

3 Technical education is not a new subject for discussion in this Society. It came before it at its first meeting in 1880, and I trust it will be brought up as often as the times seem to warrant its consideration. New fields of industry are continually opening up, inviting workmen to enter them, but as practice must always precede theory, so the courses preparing technically skilled workmen for these fields must inevitably lag behind the demand for such workmen, and the needs of the changing situation must continuously demand attention.

4 Looking backward over the history of the development of industry during the past fifty years, I think that technical education has taken its part so far pretty well. The question is—How shall it continue? Let us examine Professor Jackson's proposition. (The italics in the following quotations are mine.)

5 In the first place, taking his premises,—The closing sentence of Par. 8 states: "For eight or ten years such student engineering courses in the industries have been springing up *in large numbers all over the country.*" The closing sentence of the succeeding Par. 9 states: "Today, *on account of this new type of post-graduate industrial education,* every young man who has received his bachelor's degree and who has a fair modicum of brains and common sense has fields innumerable which lead to positions of responsibility and usefulness, etc." Par. 34 states: "Student engineer courses have grown *to their present proportions* on account of the positive need, etc." And again, in the closing sentence of Par. 36: "The simple

and practical engineers' collegiate apprentice course *is here* forming and drawing together bands of technical men, probably *far outnumbering* and outclassing in proficiency any earlier organization in the world."

6 Now, let us see the basis of Professor Jackson's statements regarding this great educational development in the industries. He says in Par. 7: "Early in the past decade . . . . certain far-sighted managers connected with the Westinghouse, General Electric and Western Electric Companies and other industrial concerns had been employing some of these men (who were being graduated from the scientific colleges) and were putting them through a more or less rigorous course of preliminary training." Three are here specifically named, but the latter of these I know personally had no student course. Again in Par. 12 and following he quotes from letters received from men now directly in charge of young graduates at the works of the General Electric Company, Westinghouse Electric and Manufacturing Company, Fairbanks, Morse and Company, Allis Chalmers Company, Western Electric Company, Stanley Electric Company, Union Switch and Signal Company, Baldwin Locomotive Works and The Pennsylvania Railroad Company;—nine in all, including the three previously mentioned, but of these I know that only the first two have student courses.

7 Four years ago while I was engaged in reorganizing a department of the Westinghouse Company, I suggested to Mr. Downton who Professor Jackson mentions as being in charge of their students' course, that he write an article on his department for the "Engineering Magazine," which he did. At that time he corresponded with other concerns about the country to learn what they were doing and found only the General Electric Company doing the same thing. He found that the Brown and Sharpe Manufacturing Company had an advanced apprenticeship system as did the Baldwin Locomotive Works and R. Hoe and Company, but no students' courses such as Professor Jackson describes.

8 In a recent issue of the "Engineering Magazine" appears a very comprehensive article on "The Present Status of Apprenticeship Systems." From this I quote: "In a few plants an effort has been made to *systematize the mode of employing, instructing aud promoting apprentices.* The classic examples in America are Brown and Sharpe Manufacturing Company, R. Hoe and Company and Baldwin Locomotive Works." And again, "Of American factory schools there are but a very few worthy of serious considerations. The apprenticeship schools of R. Hoe and Company, of New York, The

General Electric Works, at East Lynn, together with the Casino technical night school, conducted in connection with the Westinghouse plants are the notable schools of this sort."

9 Recent inquiries of my own corroborate this information, namely, that there are really only two such student schools in America, those of the General Electric Company and The Westinghouse Electric and Manufacturing Company. The reason for this is very evident when we look into the facts of the case.

10 In these days of close competition no ordinary commercial or industrial enterprise can afford to establish and maintain a technical school. Education is expensive. The technical schools about the country are all poor and constantly soliciting donations. Unless it can be reasonably assured that its student body would remain with it permanently no enterprise of the kind referred to can afford to do any educating except to the extent of developing the skill of its employees in their special craft. The two companies mentioned above, however, are not of the ordinary kind. They stand in a class by themselves. They openly state that they purposely educate young men whom they do not expect to stay with them, in order that they may act as future salesmen. Quoting from the letter on Page 180, which Professor Jackson received from the man in charge of one of these schools, the third sentence from the bottom states: "In fact we are just as anxious to have a good man with our customers as we are to retain them in our employ." And the man in charge of the other says on the next page, sixth paragraph from the top: "Seventy-five per cent of the men will be given positions of responsibility in the company's service or be placed by the company in electric lighting or railway work, which is quite to the company's advantage, since the young men will be in the field with a thorough knowledge of the products manufactured here."

11 I do not know of any other industrial concerns in the country who manufacture a commodity which so specializes its workers that after they leave their employ they are fitted only to become consumers of it in the same field. This field is practically monopolized by these two companies, and naturally a man who has been educated to use one type of this commodity will incline to advocate it when the opportunity presents itself. These companies can well afford to fill the country with well educated salesmen to whom they pay no salary.

12 But these two concerns educate their students along electrical lines only. Professor Jackson has been misinformed if he supposes that there are other concerns that are doing this same line of educa-

tional work in other fields. He says that every young man who has had a bachelor's degree, etc., can on account of this new type of post-graduate education, *i. e.*, take this course, and yet I am given to understand that there are from 1000 to 1200 students' names on the lists of applicants for admission to these two schools alone. Where are the other schools to which the other many thousands of young men with bachelor's degrees can go? It is possible that they exist, but I have failed to find them.

13 If all the industries were as fortunately situated as the electrical, Professor Jackson's reasoning would apply, but they are not.

14 R. Hoe and Company, Brown and Sharpe Manufacturing Company, Baldwin Locomotive Works, Warner and Swasey, The McCormick Plant of the International Harvester Company, The National Cash Register Company, The Allis Chalmers Company, The Santa Fe Railroad, The Colorado Fuel and Iron Company, and many other industrial establishments have apprenticeship systems, but such systems, not quite so well organized, have existed for years. The National Metal Trades Association has formulated a set of conditions which is recommended for incorporation in its members' apprenticeship agreements for their improvement, and they are very elementary. But such improvement is not by any means the post-graduate technical education that Professor Jackson means. His premises in stating his solution of the problem are based on misleading data, and merely confuse the discussion.

15 Competition is compelling every enlightened employer to secure the best help he can and improve it all he can with the means at his disposal. And what are those means? First: local trade schools as for instance, in New York, the Cooper Institute, the Achmuty and Baron de Hirsch Trade Schools, that of the General Society of Mechanics and Tradesmen, and others; in Brooklyn, the Pratt Institute and the Polytechnic Institute; in Philadelphia, the Franklin Institute and the Drexel Institute; and the Williamson Free School of Mechanical Trades, Williamson School P. O., Pa.; the Boston Trade School, that of the Massachusetts Charitable Association and the Mechanic Arts High School, in Boston; the Ringe Manual Training School, Cambridge; the Technical High School, Springfield; the Artisans School, Syracuse, N. Y., of which our Professor Sweet is director; the Armour and the Lewis Institutes and the John Worthy School, Chicago; the Maryland Institute, Baltimore; the Tuskegee Industrial Institute, Va.; the California School of Mechanic Arts, San Francisco. The above are examples of many that are scattered generously over the country.

16 The Pennsylvania Railroad, the New York Central Railroad and many others use the Young Men's Christian Association. Correspondence schools are doing coöperative work.

17 Professor Jackson need not despair of the lack of sources for securing instruction for ambitious employees, if only the latter are fortunate enough to have an enlightened manager who will encourage them to take advantage of their opportunities. But if Professor Jackson will encourage colleges to establish courses in the art of *management* he will come very close to reaching a solution of the problem in hand.

18 The majority of the factories in the country are not fit places for self-respecting mechanics to work in. They are dark, badly ventilated and unsupplied with the ordinary amenities of modern civilization. The foremen are illiterate and know nothing of the principles of economic management. They are practically slave-drivers. They say to the operatives: "What right have you to think? I will do the thinking; do as you are told and do it quick, that is what you are here for." Such conditions do not tend to encourage employees to seek for means of self-improvement.

19 The paper of Mr. W. B. Russell on the "Industrial Education" which deals with the Apprentice System of the New York Central Lines, is to my mind very much to the point. Paragraphs 3, 17, 20, 21*a-b-i-j* and 22 contain certain principles which must be recognized as essentials by the management before any kind of instruction can be effective. As Mr. Russell says: "In comparison with these, mere details of the apprenticeship system are absolutely insignificant."

20 A few colleges have already established schools which are preparing men to fill the managerial field. The Chicago University, the University of Illinois, the University of Pennsylvania and the New York University, each has a school of Finance and Commerce. Stevens Institute has a course in Business Engineering. The Clarkson Memorial School of Technology, at Potsdam, N. Y., has for five years been doing splendid work along these lines.

21 The human element must receive at least as much attention as the inanimate machinery which is so carefully preserved and kept in order.

22 It has been said that selfishness is man's dominant attribute and that the sooner we recognize that fact the better we will understand the human nature with which we have to deal and will save time and money in striving for ideals.

23 If this be true, then the colleges should teach that enlightened selfishness will pay better than mean selfishness; that the ethical principle in the golden rule is an economic principle.

24 Let the colleges teach that the one difference between a machine and a man is that one has no brains and the other has, and that it will pay to utilize the potential knowledge which those brains possess.

25 Let the colleges teach that the way to meet competition is by strengthening one's organization by development instead of weakening it by squeezing its life out by brutal arrogance.

26 Let the colleges teach that if the American industrialist does not take a broader view of the field than is presented to him through his shop window or by looking over his back fence, he will awaken some day to the fact that his sordid selfishness has caused him to yield to the enlightened methods of Germany.

27 Let the colleges teach the manager to give attention to the health, the morals and the mental development of his workingmen, and he will find that healthy, sober, intelligent workmen will prove to be eager for self-improvement and will turn out more and better work, even under ordinary management, in light comfortable and cheerful rooms than will cheap ignorant help in dark cold rooms under a score of half-frozen functional foremen. The Massachusetts Board of Education is now laying a foundation in these directions in its primary, secondary and high schools, which is worthy of adoption by the colleges.

28 By the adoption of these fundamental principles of social economics and the knowledge of modern methods of scientific business management every industrial establishment will become an adjunct to the college; a blessing instead of a curse to the community in which it is located; and a potent force in the nation, tending to forward its advance toward permanent commercial and industrial supremacy.

MR. CALVIN W. RICE I want to state my own experience, because I think it is different from what Dr. Hammerschlag has said.

2 I started with about fifteen other fellows who happened to be in my apprenticeship, and worked for 10 cents an hour, and lived on it nine months; I could have lived on it two years, if necessary. I paid $1.25 a week for my room, and $3.25 for my meals on a weekly ticket, and I had left a couple of dollars for spending money. To be sure, I had my clothing when I started, but this item did not cost much because I wore overalls all the time. It was popular to be poor, and I think it is possible now, as I know it was then, to myself and friends, to live on 10 cents an hour and be respectable, and to get washed up after the day and make a social call in the evening like any other person.

3 These are facts, and I have been through the experience. After having served nine months as an apprentice I was promoted to foreman first at $9 per week, and then $12, and as such I have handled probably several thousand young men who have passed through departments under me. Each of those young men received 10 cents per hour. They were certainly alive to their opportunity and the majority developed the very traits which Dr. Hammerschlag says must be developed in order to be men. In less than two years, which was the length of the course, the average man was promoted out of it and into a practical position. The facts are, I think, that rarely does a man remain through the two years. He is sometimes promoted out of the course in six months into a position of responsibility. The demand for a good man is very great. They are sent out on jobs very soon after they have learned even a smattering of the assembling of parts and the operation of machines. They are also sent out to instal apparatus; they meet the men of affairs in the world who are purchasing the apparatus, make friends, get offers of good positions, and immediately go from a position of ten cents an hour to a position of $15 or $20 a week, on the outside, and it is impossible for the parent company to keep them.

4 One of the reasons which the parent company has for paying this low wage, is that the mistakes that are made are very expensive. I have seen a young man make a mistake in connecting up a dynamo, causing its destruction, that was worth perhaps two or three thousand dollars. There was no punishment. If he were discharged, a promising man was lost to the company, and the amount of damage cannot be taken out of his pay.

5 Admitting that manufacturers for selfish reasons train men for their own company I feel that they are doing a practical service and are achieving the desired results. Now, I ask for information. Specifically what do you want? From each of the speakers of the evening there has been a request for coöperation. I think, if you are going to make progress you should specify the kind of coöperation you want that you do not have now.

6 I am personally acquainted with the men in several of the larger companies that are carrying on these courses, and they are exceptional men to whom the word "coöperation" is a life motto. Now, I know if there is anything lacking that you can suggest specifically it will have very careful consideration.

7 Further, you know very well, that the professors of the colleges are welcome any time to take their students to the factories and stay there a week or longer. On the other hand the practical men at the

manufacturing establishments are delighted and feel honored by being invited to come and give lectures at the colleges.

8 Again, men from the Society consider it a great honor to be called on to serve on boards of visitors. One of our Council considers it a great honor to serve on the Board of Visitors to Brown University, to visit the mechanical engineering department. Here then are the manufacturing interests, the colleges, and the societies desiring to coöperate, and I think this meeting will accomplish results if the gentlemen here, and we have a splendid representation, will name specifically what is needed.

MR. D. A. TOMPKINS Following a proper education of a general nature and comprising moral, mental and physical training at home or in the kindergarten, and at suitably light work in proper proportion, there comes a period where technical education is begun or where real work is entered upon. Industrial work requires the application of both science and art. The man or woman who is both *instructed* and *trained* is capable far beyond one whose training or education has been one sided, that is, in a college only or in a workshop only.

2 In modern industrial life it is desirable to have the same mixture of actual practical work and of scholastic and technical training. This must of necessity mean scholastic and technical schools within reach of the young working people; it must mean the maintenance of common schools and special schools with teaching adapted to special industries. The common school work and the special school should both be coupled with an apprenticeship system in some practical work. Every boy and young man should have an apprenticeship connection with some practical work, just as the boy on a farm goes to school and yet has always more or less to do with farm work, not generally by design but by force of surrounding conditions.

3 As the cry of the kindergarten teacher is ever to get possession of children at an earlier age, so an apprenticeship is more valuable as the boy or girl is started young. All apprenticeship work of young boys and girls should be as carefully guarded as the kindergarten work of infant children, but it is exceedingly important that the apprenticeship age should be reduced rather than extended.

4 In a plant consisting of a machine shop, foundry and pattern shop, at Charlotte, N. C., the author has developed an apprenticeship system which has been exceedingly satisfactory and productive of good results. The idea at the beginning was to take apprentices at and above 16 years of age, and none younger. All our experience

has shown that 16 years is entirely too old. The best learning period has been passed. We have found that the younger the apprentice is indentured the better. We arrange so that each apprentice shall be under a sort of foster-father care of a journeyman. The work of young apprentices is during part of the vacation of the common school term and at such other times as he may be spared. The apprenticeship often extends throughout a college course.

5 The terms of this contract include a designation of the trade to to be learned; the term of apprenticeship, which is three years; and the compensation the apprentice is to receive during the first, second and third years. The agreement continues as follows:

By mutual consent the apprentice may interrupt this apprenticeship service to go to school, but shall not be thereby released from completing this apprenticeship term of 300 days per year for three years, or 900 days all told, exclusive of interruptions or deductions, either on account of school, or sickness, or any other purpose. At any time in the first six months, either party to this contract may cancel it, the first six months being a period of probation.

Two grades of certificates will be given as follows:

The certificate Class A.A. will be given to the apprentice who has averaged 6 months at school or college each year of his apprenticeship. This certificate with a general shop average of 100 being the award of highest possible merit. No apprentice falling below a general shop average of 75 will be given a Class A. A. certificate even though he may have complied with the requirements of six months at school or college.

The certificate Class A. will be given to those who serve the full apprenticeship term and make an average of 75, or above, but who are unable to attend a school or college as required above.

The General Shop Average for the full apprenticeship term will be determined from the weekly report cards handed in by the department foreman. The averages on the weekly cards are graded as follows:

ATTENDANCE—60 hours per week are 100 per cent.

PROMPTNESS—Prompt during the whole week are 100 per cent.

CONDUCT	Good, 61 to 100 per cent. Fair, 21 to 60 per cent. Bad, 0 to 20 per cent.	SKILL	Good, 61, to 100 per cent. Fair, 21 to 60 per cent. Bad, 0 to 20 per cent.
DILIGENCE	Good, 61 to 100 per cent. Fair, 21 to 60 per cent. Bad, 0 to 20 per cent.	ACCURACY	Good, 61 to 100 per cent. Fair, 21 to 60 per cent. Bad, 0 to 20 per cent.
RAPIDITY	Fast, 61 to 100 per cent. Medium, 21 to 60 per cent. Slow, 0 to 20 per cent.		

It is desired that each apprentice shall take a vacation of one month in each year and spend it, preferably, on a farm in the country.

Each apprentice is assigned to a selected journeyman mechanic who will look after his welfare and his training.

The apprentice may be discharged at any time for such cause as dishonesty, misrepresentation, grossly bad conduct, disobedience, gross neglect of duty, or other similar offenses.

The apprentice may quit at any time if wages are not paid, or if he be ill treated.

6 The foregoing relates to industrial education where common schools and colleges are used for scholastic and technical training in regular courses. Practically the only fault to be found with the colleges is that they are not accessible except to a limited class. The colleges and universities with their immense endowments are within the reach of comparatively few. The difficulty is threefold, *a* they are inaccessible for the working youth, *b* the cost of the prescribed course is beyond his reach, and *c* the usual course of four years must be taken bodily out of the working life of the young man. The same is true of State supported institutions. The colleges and universities stand above the working youth and refuse to give that special scholastic or technical training. Indeed some of the endowed colleges and universities and some of the State supported ones lay such stress upon the importance of a four years course of scholastic technical training that they actually spoil what might have been, with some practical training, a very capable man.

7 That there is a field for a more widely diffused education, within reach of the working youth, is made plain by the growth of the modern correspondence schools; by the wide field of usefulness of the modern business college where a boy or girl goes to learn some specific thing well enough to make a living; by the success of the educational departments of the Young Men's Christian Association and the Young Women's Christian Association; by the necessity in big modern manufacturing corporations of operating special schools often within the works and by the schools founded by and in the big department stores. In most of these cases, even in the Christian Association educational departments the instruction received is paid for at full cost. This is nothing against these institutions and it is to their credit that they give to the working people that supplemental instruction so essential to make the common school education practical in earning a living. The only reproach is that with all the gifts by philanthropists and all the appropriations by States, the tendency in the institutions founded and maintained by them, the education rarely, if ever, reaches the real working boy or girl. There is, with a vast number of working people, a little gap between their common school education and that leavening education which qualifies the young man or young woman to "make a living" for themselves and

become far more useful to the community. The filling of this gap may, in some cases, be accomplished through the correspondence schools, the business colleges, or other schools but for the young man or young woman who is in manufacturing pursuits it would be infinitely better if a system of special instruction and training could be operated in the midst of the homes of the working people. To be most useful such schools would have to take instruction to their very doors; the hours must suit the working time and the instruction must not interfere with the regular work nor diminish the regular wages of the working boy or girl.

8 In the past the college has given an excess proportion of mental training, while the boy or girl who has to work and cannot go to college has an excess of practical training. In the field of common school and college training it is exceedingly desirable that a practical apprenticeship be coupled with the school and college course, and that for the boy and girl, in fact. also for young men and young women there should be schools of special instruction located in the midst of the homes of the working people with subjects taught which relate to the particular trades in the neighborhood.

9 Further appropriations by States and further gifts from philanthropists would accomplish much more for the general cause of education and for the advancement of civilization if a part were applied to such practical education than if given to institutions already heavily endowed, for making higher education come still higher. The writer, far from deprecating any form of higher education, thinks it is questionable whether, after reaching a certain point of cost, any further expenditure does good, but rather does harm by increasing costs.

10 An apprenticeship in early life which would entertain the child, as children of the farm are interested and entertained by taking a light hand in the work of the farm, would save the child from drifting away from a taste for work and would give an apprenticeship at an age of quickest impressions.

11 If, in addition to such apprenticeship, on going to work, the youth could spend evenings and other spare time in schools which would still further increase the usefulness of the common school and apprenticeship training, then the value of the man would be increased three to tenfold.

Mr. C. B. Rearick One weakness of technical schools is a tendency to encourage men to proceed with studies in engineering when they have no natural inclination in that direction. It is not always the

schools themselves that encourage it, it may be the parents, or it may be from a number of different sources, but very often they try to make an engineer out of a man who would make a better doctor, or a better lawyer, or a better business man, and if there were more conscientious work in weeding on the part of the technical schools, which have such timber in the early stages, perhaps our technical men would have a higher standing among the manufacturers.

Prof. William D. Ennis There are some practical complications in the development of the special apprenticeship system in ordinary machine shops. These shops have no testing departments or other special places particularly adapted for utilizing technical men, but must place all of the men directly in the productive departments, where, as Mr. Taylor suggested, they are on the same basis as the other men. Unfortunately the result is too often that the young college men "are like the chaff which the wind driveth away." Some of the fault of this is with the men, some of it lies with the schools, and not a little of it is attributable to the conditions of organization in the factories. Furthermore, a surprisingly large percentage of the technical men remain and succeed, although, as one speaker intimated they are heavily handicapped by their diplomas. Of those who do leave, some, of course, leave for better positions. If the technical men were wholly undesirable, manufacturers would not want them, and they certainly do want them. The most notable thing about this question is that these men are wanted, not for engineering positions, but to be trained for what may be called the *line* positions in the industrial army. In the old organization of industry, there was no systematic training of men for leadership. Leaders developed by a process of natural selection. As has been said, this produced admirable men, but not enough of such men. We must now practice a form of *regulated* natural selection. All manufacturing is engineering. Superintendents and managers ought to develop from among the body of engineers rather than from among the clerical force. In this respect mechanical engineering and mining engineering are quite distinct from the civil or electric engineering professions.

3 The study of the last two branches of applied science results in the production of expert engineers who should thoroughly know one narrow subject and should be able to master its applications to all conceivable subjects. The mechanical engineer, however, usually becomes a part of a factory organization; in which he is required to be a good manager rather than an expert machine designer or power expert. His function is to be able to apply to one specific industry,

all of the principles and methods of engineering. To train men who can do this, we must allow them to grow in the manufacturing plant through gradually increasing responsibilities, insisting upon the application of engineering methods at each step. To carry out this program, certain requirements, stated by Professor Jackson, are essential.

4 The manufacturers must be, as they usually are, broad enough to balance a present annoyance against a future gain. The apprentice must be given a fair show, and should be under the general charge of some high grade man, preferably an officer of the company, who will see that they are given the kind of training that is planned for them.

5 By this is understood, not their being retained in some one department where they have learned to do one thing chiefly and well, but their being "shifted" systematically, regardless of considerations of departmental production, in order that they may get the well rounded experience that the manufacturer finds it profitable to give them.

6 The most vital point of all, however, has not been touched upon. Our technical men have a hard time of it for the first few months because they do not know how to take hold. They need teaching in the policies and methods of the manufacturing plant. They should be shown how in actual business affairs it is essential and desirable that every man's work be accurately, constantly and comparatively weighed by a just standard of value. They should learn the principles upon which such standards are established, and that most fundamental principle, that the individual work alone is a small factor in the result, while the coöperative effect of many men working along different lines toward a common end is an overwhelming factor. To some extent we can teach students the forms of business organization, the principles of business management and correct industrial ideals. Then, when they take business positions, they will more quickly "get hold." The same training ought also to teach them the importance of straight forward self reliant effectiveness and the abomination of half-accomplishment, excuses and philandering.

Mr. Fred. W. Taylor It appears to me that in the discussion of Mr. Jackson's paper perhaps two of the most important elements in the training of college graduates and students who come into industrial life have not been touched upon.

2 The intellectual life of the student, up to the time of his leaving college, has been almost exclusively that of absorption. He

has been learning how to get and assimilate knowledge of various kinds. He has learned perhaps a few and perhaps many facts and principles which will be useful to him later on, but if he has really done well he has learned how to go about quickly getting and assimilating whatever facts he may need in the solution of any particular problem with which he may be confronted.

3 Briefly stated, again, his education up to the time of leaving college has been learning how to absorb. After leaving college and throughout the rest of his life his chief concern will not be absorption, but construction; he will have to learn how to put what little knowledge he may have into effective, practical, every-day use, so as to obtain definite results.

4 The chief function, to my mind then, of any shop work which the college student should do, either during vacation or immediately after leaving college, should be not the acquisition of additional information, but learning how to successfully use what information he has. The graduate or student who starts to work in a shop should go there filled with the idea that he must learn how to do a good ordinary day's work. The average young man, on leaving college, however, is still under the impression that it is most important for him to gain additional information. Four-fifths of the work of the engineer, or superintendent, or manager, is dull, and monotonous, and demands first of all the ability on the part of the man to endure plain, ordinary, disagreeable work. At college, while the intellectual work of the student is often severe, it is always interesting, and presents at least the attraction of novelty and a certain stimulating excitement. That of the successful engineer or manager, however, is monotonous and commonplace by comparison, and in their college training they have not been taught to do work of this sort.

5 The chief mistake, then, to my mind, which is made by the young college graduate who comes into a shop, and also by many of those who prepare the shop courses for these young men, is that they have their eye on the least important element in the shop training. In my judgment, many unhappy hours would be saved to the students and months and years of partial failure would frequently be saved them, if they came to their shop work with the idea clearly fixed in their minds that they are there primarily to learn how to do an ordinary day's work in straight competition with workmen who are earning their living.

6 Next in importance to learning how to work, to my mind, comes the necessity for the young graduate to become intimately acquainted with the view point and methods of thought of the great

mass of mechanics who are working for their living. The college man should expect some day to be a leader, and to direct the work of other men, and unless he learns how to talk with workmen on their own level; how to successfully compete with them in doing every-day, monotonous work; and unless he acquires a certain respect and kindly regard for these men, his chances of ever becoming a successful leader are comparatively small.

7 For these reasons the young graduate while he should be given a good variety of work, still he should not be put to work on jobs, specially prepared and selected with a view to having him absorb an additional amount of information very rapidly. He should be given a daily task, right among the mechanics of the shop, and in keen competition with them, and the object of those who are training him should be to see that he does a good big competitive day's work. The young man who succeeds in holding his own in this way with other workmen comes out of his post-graduate shop course with an amount of self respect and also of respect for the men around him which will place him far on his road towards success as a leader. It is for this reason that, on the whole, the system of instruction apprenticeship described by Mr. Russell as in use in the New York Central shops appeals to me as, on the whole, preferable to that in use in the General Electric and Westinghouse Companies. In the latter companies, if I am rightly informed, the young college men are in competition with one another rather than with the workmen, and the first consideration in their minds is that they are there to absorb as large an amount of additional information as possible.

8 I believe that the young engineer would get the greatest good by taking one year of hard practical work in a machine shop or other industrial establishment right in the middle of his college course; say at the end of the freshman year. He would come back from a year spent in this way to college far more sober, earnest, and determined to learn and make the most of his college opportunities. I am endeavoring to arrange for a plan of this sort by which a certain number of college students will be regularly given work in the shops of a company where daily and severe tasks are given to each man, and where the force of functional foremen and instructors is ample to see that each man does his full day's work, and that he uses only the best methods and implements for doing this work.